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EDITORIALS

NECESSITY FOR A CHAIR OF TRAUMATIC SURGERY IN MEDICAL SCHOOLS

AN ANSWER

An editorial by Dr. C. R. G. Forrester in the April, 1936, edition of the *American Journal of Surgery* develops the thesis that a course in traumatic surgery is an essential necessity and should be given by a Professor of Traumatic Surgery in all medical colleges.

No one can take issue with the proposition that the surgery pertaining to industrial and accidental injuries can be improved by specific education in that line of endeavor. That improvement will ensue solely as a result of efforts to that end expended by teaching in medical schools may be open to argument.

Most schools begin surgical teaching in the third year, continue it through the fourth year, including a clinical clerkship and dispensary attendance.

With medicine, obstetrics, gynecology and the specialties demanding their proper allocation of time, the hours of the student are well occupied. The man looking in finds it easy to demand time for his pet subject; but it is not so simple for the gentleman who is inside, and whose duty it is to see that a well balanced medical education is provided for the student under his supervision.

No one, I am sure, denies that every bit of knowledge obtained either in or out of college is of value (if retained), but in this matter of "traumatic" surgery the question, to my mind is, when may the subject be taught as a specialty, if such it is, to the best advantage?

Surgery is surgery, and whether it is called upon to function because of an accident, or by reason of other causes, the principles of surgery still apply.

Principles of surgery, a knowledge of wound healing and surgical pathology, are in essence the most important

requirements in the handling of accidental injuries. Knowledge of proper methods of debridement; when primary, delayed primary, or secondary suturing should be utilized; how to properly treat shock; the importance of immediate immobilization of fractures; the need for rest more than ambulances in roadside injuries; the necessity of examination for peripheral nerve injuries; all of these fundamentals should be, and without question are, a part of every course in surgery taught to undergraduates.

These principles should be hammered home, if necessary by recitation of case histories depicting the serious consequences to a bread winner because of failure on the part of an attending physician to recognize well established principles.

Having faithfully taught surgical principles, diagnosis, and having outlined and demonstrated treatment, members of the surgical faculty of a medical college have, it seems to me, fully discharged their duties to their students.

When then, should the subject of "traumatic" surgery be taught? Why not at the time when physicians have opportunity of applying their knowledge? Forrester states, "None of us are going to live forever and our places should be filled by capable and competently trained men who will follow us." Agreed! That is the place for course number one. Under the guidance of just such men as Dr. Forrester, one or more assistants can be trained in the work, at the anvil. I am sure as many applicants for such assistantships would be on hand as there are, as Forrester states, "young men asking what University gives a good traumatic course." Whether this means a postgraduate or undergraduate course he does not state; the latter is implied. If so, one wonders what is in the minds of prospective students when they are looking for a school which gives a good "traumatic" course.

Course number three may well be under the supervision of medical societies, which again would give the "traumatic" surgeon opportunities for promulgating his ideas relating to proper handling of patients accidently injured.

Forrester states, "Traumatic surgery can not be taught by a general practitioner . . . "; the inference is that it is being taught by men who are not surgeons. This is a surprising comment. His statement that courses of "traumatic" surgery are not available because of the " . . . local situation of competition, jealousy, lack of cooperation and understanding in each University . . . " is a rather broad indictment.

I hope I have shown the entirely altruistic group of "traumatic" surgeons how this utter "lack of understanding" can be circumvented and the injured individual have better care than he now gets. I do not deny that there is much room for improvement. I do deny that it can be gained by an undergraduate course in "traumatic" surgery. The reasons should be apparent. Not the least of these is the long wait between the time of graduation and the happy moment when the young man in practice finally has the opportunity to apply his knowledge. This chance usually presents itself as a result of his good fortune in chancing to be on hand at the time of a highway accident, or his even greater good luck in being called to care for an injured workman during the absence of the "traumatic" surgeon in charge of that type of work for one of the corporations which, as Forrester says, " . . . today have their private medical set-up and employ the best men they can get and the best men are only too glad to accept the positions offered."

Frederick S. Wetherell.

PNEUMATOLOGY

DURING the last ten years the use of gases for therapeutic purposes has become increasingly important. The technician who delivers and operates oxygen therapy equipment in the home and in the hospital is a familiar figure. The highly trained rescue squads of the Police and Fire Departments, the Industries, and the Utilities whose technicians employ gases for the saving of life operate separately and appear in no way related either with the Oxygen Therapy group or with the quasimedical technician who administers gases for the control of pain. Each group, completely isolated one from the other are directed by medical personnel, having as little in common, i.e., the internist, the police surgeon, the anesthetist.

The bond of common interest, the common denominator, the factor which integrates these separate activities into a single work, namely the use of gases for therapeutic purposes to treat disease, to save life, to control pain, appears to have been entirely overlooked.

Granting the existence of this state of affairs, and assuming the desirability of uniting these scattered activities, at least from the standpoint of the dissemination of knowledge and the accumulation of experience, we may well ask the reason why these activities have not been united and offer a suggestion by means of which they may be brought together.

That the situation is recognized and is being met in a number of universities and hospitals by forward-looking physicians in charge of Departments of Anesthesia, who offer the services of this department to care for the administration of gases, but serves to bring into relief a fundamental difficulty which by its very nature retards such a desirable integration. We refer to the restriction imposed upon the physician by the terminology, "anesthesia," the control of pain. Why should a physician whose speciality is limited to the control of pain, by reason of this calling, be requested to care for asphyxia neonatorum, carbon monoxide poisoning, submersion, terminal polio, or be asked to treat anoxemia due to acute pulmonary infection, or to cardiac decompensation? Is it not too much to expect that the nature of anesthesia is so generally understood that the ability of the anesthetist to treat asphyxia is implied? Does not the terminology, "anesthesia," serve as a definite resistance to any effort which may be made to relieve the situation?

While "a rose by any other name may smell as sweet," yet without a commonly accepted generic term, the horticulturist would promptly be brought to a standstill. Is it not greatly to be desired, therefore, that a descriptive generic term, to include the specific activities, now known as anesthesia, resuscitation and oxygen therapy, be promptly adopted?

In a search for such a term, among those responsible for the nomenclature of disease, the following terms have been suggested: Inhalational Therapy, Asphyxial Medicine, Apnotherapy, Aeriotherapy, Aerotherapy and Pneumatotherapy.

The term selected should have a sound derivation, a certain familiarity in appearance and lend itself to an elaboration to cover the science, the technique and the technical personnel.

Inhalation Therapy and Asphyxial Medicine do not lend themselves to the acceptance of the suffix, "ology, or science." Aerotherapy and aeriotherapy while descriptive of the use of gases for therapeutic purposes savor too much of aeronautics. Apnotherapy, signifying breathlessness, lacks familiarity. Pneumatotherapy is suggestive; it is derived from the correct roots and suggests inclusiveness. "Pneumon," lung, and "pneumatics," the science of gases, is covered by the scientific term, "pneumatology," which is readily ex-

panded into "pneumatotherapy" and "pneumatological technician."

Should "pneumatology" be found acceptable, it would include as a generic term, the specific activities referred to as anesthesia, resuscitation and oxygen therapy. The objection that anesthesia includes also the use of local, conductive, rectal and intravenous methods may be met by the fact that at least 80 per cent of all anesthetics administered are produced by the use of such gases, as nitrous oxide, oxygen, cyclopropane, ethylene, ether and chloroform, the vapors of the last two being regarded as gases, in practice. It is to be expected that the personnel engaged in the field covering the larger volumn of patients, and providing routine material as well as a wide experimental background, namely anesthesia should provide the personnel from which the pneumatologist would be evolved. The pneumatologist would radiate instruction and control over the non-medical personnel now engaged in the administration of anesthetics, oxygen therapy, and in resuscitation. The pneumatological technician would fall into his natural relationship to medical direction and control. Owing to the scope of the field, the present competition existing between the technical and the medical group would be automatically eliminated.

As the first step, therefore, in the coordination of the disorganized fields of gas therapy, which now exists, the acceptance of the generic term, "pneumatology" is proposed.

Paluel J. Flagg.

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OSTEOGENIC TUMORS OF SCAPULA*

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THE earliest record I have found of removal of the entire arm and scapula is the famous case of Samuel Wood, the miller (1737), related by Cheselden in his "Anatomy of the Human Body." The arm with the scapula was accidentally torn from his body by a rope winding about it, the other end being fastened to the cogs of a mill.

The first recorded surgical attempt at partial excision of the scapula was that of Von Walther, in 1811; the operation was performed for a "spongy swelling" and the patient died fourteen days later of exhaustion. Wutzer, in 1825, successfully removed all of the bone except the processes for medullary "osteo cancer," the patient succumbing to recurrence four years later. Textor of Heidelberg, successfully removed an enchondroma in a child of twenty-six months the excision involving the infraspinous portion of the bone. Carnochan of New York, was the first American surgeon to record a successful partial excision.

Total excision of the scapula was first performed by Syme of Edinburgh, in 1856. Rogers of New York, in 1868, reported a case in a girl of seven years who died of intrathoracic metastases. His paper is admirable and contains interesting tables of collected cases. Veit, Finkelstein and Felsing were early contributors to the German literature on this subject.

In an effort to determine the results of the treatment of osteogenic tumors of the scapula, a thorough study of the cases from our series at the Memorial Hospital as well as all the cases of scapula sarcoma from the Bone Sarcoma Registry, was undertaken. This, together with a survey of the literature on the subject, forms the basis of the present report.

The scapula is an infrequent site for the development of a bone tumor. The Bone Registry records but 39 cases, of which 29 are malignant and 10 benign. The Memorial Hospital† contains records of 23 malignant scapular tumors.

This study is concerned primarily with the treatment of osteogenic tumors, so that only the 19 cases from the Bone Registry and the 18 cases from Memorial Hospital which are true osteogenic tumors are considered here. Cases of periosteal fibrosarcoma, myeloma, Ewing's sarcoma, etc., are excluded.

Of the 37 cases in the combined group, 33 are classified as osteogenic sarcoma and 4 as chondroma. A rather striking percentage of the osteogenic sarcoma cases are recorded as of the chondrosarcoma type. This seems remarkable when we consider that this bone is developed from intramembranous ossification rather than precartilaginous ossification as is the case with the long bones.

Sex. In the Memorial Hospital series there were 9 males and 9 females, and in the Bone Registry series there were 12 males and 7 females.

Age. In the Memorial Hospital series the average age was thirty-four years; the youngest was three years; the oldest seventy-five years. Five cases were under twenty-one years. In the Bone Registry series the average age was thirty-eight years; the youngest case was a newborn child; the oldest sixty-eight years. Six cases were under twenty-one years.

BONE REGISTRY CASES—19

1. *Treated by Surgery Only.* Six osteogenic sarcoma; one chondroma.

† To the Memorial Hospital series has been added one private patient from the Hospital for Ruptured and Crippled.

* From the Bone Tumor Departments of the Memorial Hospital and the Hospital for Ruptured and Crippled.

Five of these are known to be alive or to have survived for 13¾, 5, 3, 1½ and 1 year. There were two total and four partial excisions; the remaining case had interscapulothoracic amputation and was not traced after leaving the hospital.

The figure of Samuel Wood, a miller, whose arm, with the scapula, was torn off from his body by a rope winding round it, the other end being fastened to the cogs of a mill. This happened in the year 1737. The vessels, being thus stretched, bled very little; the arteries and nerves were drawn out of the arm; the surgeon who was first called placed them within the wound, and dressed it superficially. The next day he was put under Mr. Ferne's care at St. Thomas's Hospital; but he did not remove the dressings for some days. The patient had no severe symptoms, and the wound was cured by superficial dressings only, the natural skin being left almost sufficient to cover it, which should in all cases be done as much as may be. About twenty years since, I introduced the method of amputating, by first dividing the skin and membrana adiposa lower than the place where the operation was to be finished, the advantages of which are now sufficiently known.—Cheselden, *op. cit.* p. 321.

Fig. 1. Traumatic interscapulothoracic amputation, Cheselden's Anatomy, 1737.

2. *Treated by Irradiation Only.* Eight osteogenic sarcoma.

None of these cases is known to be alive.

Fig. 2. Illustrating the result in Syme's case, the first recorded successful complete excision of the scapula; 1856.

One was followed for seven years and then track of him was lost. The remaining cases died after 3½, 1¾, 1, 1, 1 years, 11 and 9 months. *X*-ray therapy was used alone in 5 cases, in conjunction with radium in 2, while one case had radium needles only. Lead and toxins were also used on one of the cases which received both radium and *x*-ray. Two cases had preliminary biopsy.

3. *Surgery Combined with Irradiation.* Three osteogenic sarcoma; one chondroma.

In this group one patient died one year after treatment; one was not traced after operation; and one was reported as alive with disease present six months after treatment. The remaining case, a chondroma, is apparently alive and is known to have

survived seven years. There were 4 cases surviving five or more years; one osteogenic sarcoma and one chondroma treated by surgery only; one osteogenic sarcoma treated by irradiation only; one chondroma treated by surgery combined with irradiation.

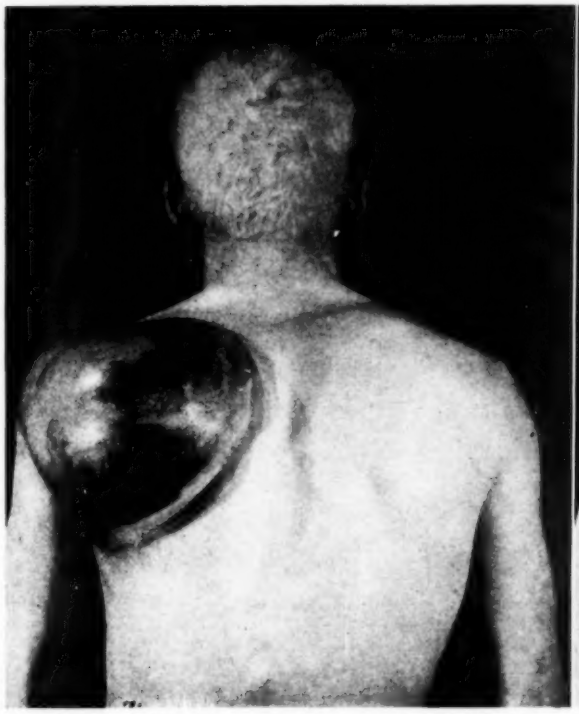

Fig. 3. Chondromyxosarcoma of scapula in albino Negro.

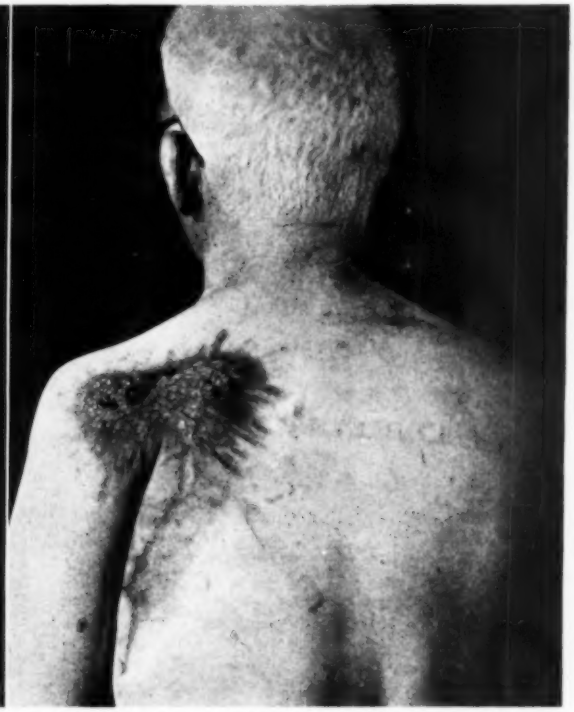

Fig. 4. Showing condition after subtotal excision of scapula. Note pinch grafts covering area which was impossible to close by primary suture.

The results of treatment in these cases prompts one to draw several conclusions. As is the case with osteogenic sarcoma in general,* irradiation has thus far been almost uniformly unsuccessful in affording five-year survivals of osteogenic sarcoma of the scapula; and because of anatomical factors, radical surgery for the osteoblastic or osteolytic offers a most unpromising outlook.

De Nancrède, writing in 1909, painstakingly searched the literature and collected 65 cases where total excision of the scapula was performed for neoplasms of that bone. He eliminated a number of cases in Buchanan's series, collected up to 1900, and added 22 cases. His statement that "an unbiased study of the 65 cases of malignant disease tabulated, where the scapula alone seemed involved, has led to the surprising discovery that not one case is unqualifiedly cured, and but one nearly certainly cured." Later he states, "thus we have one practically certain cure, and six probably cured, but one of these required a second operation, and all may have relapsed later."

He concluded with the following: "If the positive diagnosis of malignant disease can be made, I shall, I think, in the future recommend intercostohumeral amputation until this procedure also is proved to be inferior or no better in the end results than a complete excision of the scapula alone, and I shall set my face absolutely against any partial resections of the shoulder blade for malignant disease."

Felsing, in 1863, found recorded 38 scapula removals, of which 4 were extirpations, 14 amputations, 11 removal of a

* Coley, Bradley L. The treatment of osteogenic sarcoma by irradiation. *Am. Jour. of Surg.*, 27: 43–47 (Jan.) 1935.

part of the body, 5 resections of the spine and 4 resections of the acromion. Of the 38 patients, 17 died.

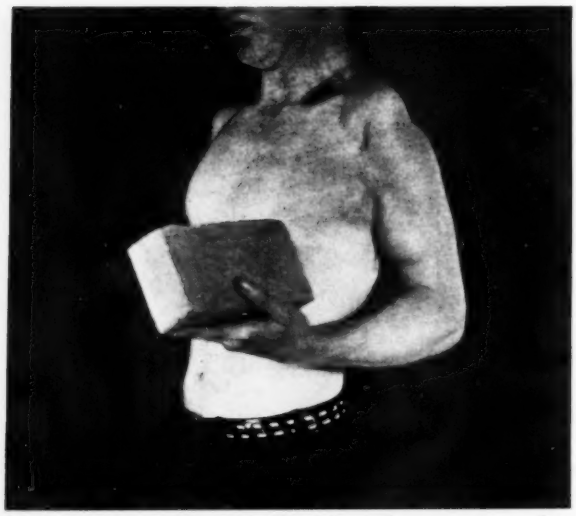

Fig. 5. Case IV. Showing function of upper extremity eleven months after operation.

It is our belief that a type of scapula tumor of osteogenic origin exists which offers some opportunity for the application of conservative surgical measures. We refer to those of cartilaginous derivation, which in the scapula are frequently secondary chondromyxosarcomas on the basis of pre-existing chondromas. The pathological report in these cases most often rendered is chondromyxosarcoma. They are apt to be found at least partially encapsulated, and they tend to infiltrate less widely and to disseminate less early than do the osteolytic or the osteoblastic forms of osteogenic

Table I
PORTION OF SCAPULA INVOLVED

	Memorial Hospital Series	Bone Registry Series
Entire scapula	5	4
Supraspinous region	5	3
Infraspinous region	2	4
Body	..	4
Spine	3	3
Axillary border	2	1
Neck	2	1
Glenoid	1	1
Acromion	..	1
Coracoid	1	
Vertebral border	..	1
Subscapular fossa	..	1

Note: In several cases more than one portion of the scapula was involved.

Fig. 6. Case V. Showing recurrent chondromyxosarcoma of scapula before subtotal excision.

Fig. 7. Case V. Shows condition after operation for subtotal excision. In this case it is seen that a total excision should have been done; it was necessary five months later for recurrence.

sarcoma. They are, however, true malignant tumors and invariably, if not removed, tend to terminate fatally.

its growth, the degree of extension into neighboring soft parts and the encroachment upon the neck of the scapula and

Fig. 8. Case v. Showing condition after total removal of scapula.

Fig. 9. Case v. Final result, August 21, 1936, one year after total excision.

Fig. 10. Case ii. Recurrent chondroma, before partial excision of scapula.

The decision whether or not to attempt resection can generally be reached after a careful examination of the tumor with reference to its fixity or mobility upon the chest wall and beneath overlying soft parts, its size and extent, the rapidity of glenoid. This examination is twofold, for the radiographic study is especially important in supplementing the physical examination.

The results of the conservative procedure of subtotal or partial excision of the scapula

in 5 personally treated cases has led us to recommend this method in selected cases of the type referred to.

TABLE II

TYPES OF TREATMENT AND FATE OF PATIENT THEREAFTER

Memorial Hospital Cases—18

1. *Treated by Surgery Only* (2 osteogenic sarcomas; 1 chondroma).

The chondroma patient is well three years and ten months; one of the osteogenic sarcoma cases died two years after operation; the remaining case was known to be alive with evidence of recurrence three years after operation.

2. *Treated by Irradiation Only* (4 osteogenic sarcomas).

All of these cases are dead, the survival periods being nineteen, nine, eight and four months.

3. *Treated by Surgery Combined with Irradiation* (4 osteogenic sarcomas; 1 chondroma).

Two of these are known to be alive; the chondroma (recurrent when treated here) is free of disease six and one-half years; one of the recurrent osteogenic sarcoma cases is well more than a year after total excision following two partial excisions and irradiation done elsewhere. Three are dead after surviving for two years, six months and six weeks.

4. *Treated by Irradiation Combined with Toxins* (4 osteogenic sarcomas).

One was traced seven months and was in bad condition when last traced; is probably dead. Three are dead; seventeen, six and three months.

5. *Treated by Surgery, Irradiation and Toxins* (1 osteogenic sarcoma).

This case had partial excision elsewhere, radium pack and radium seeds and toxins; died after four years.

6. *No Treatment* (1 osteogenic sarcoma).

Received no treatment; lived three months; case worthless.

There was one five-year survival (a recurrent chondroma) treated by surgery combined with preoperative irradiation.

SUMMARY OF CASES PERSONALLY TREATED BY PARTIAL OR SUBTOTAL EXCISION OF SCAPULA

CASE I. M. P., colored female, aged twenty-eight years.

Diagnosis: Chondromyxoma of scapula.

Operation: Partial excision of scapula, July 6, 1932.

Pathological Report: Chondroma.

Result: Examined in Clinic May, 1936; excellent anatomical and functional result.

CASE II. N. P., white male, aged forty-three years.

Diagnosis: Recurrent chondrosarcoma of scapula, low grade, from operation performed in Italy two years previous.

Operation: Excision of three-fourths of scapula, October 2, 1929.

Pathological Report: Chondroma, clinically malignant.

Result: Well six and one-half years; can elevate arm above head; free motion of the shoulder joint. No evidence of disease on examination, April 22, 1936.

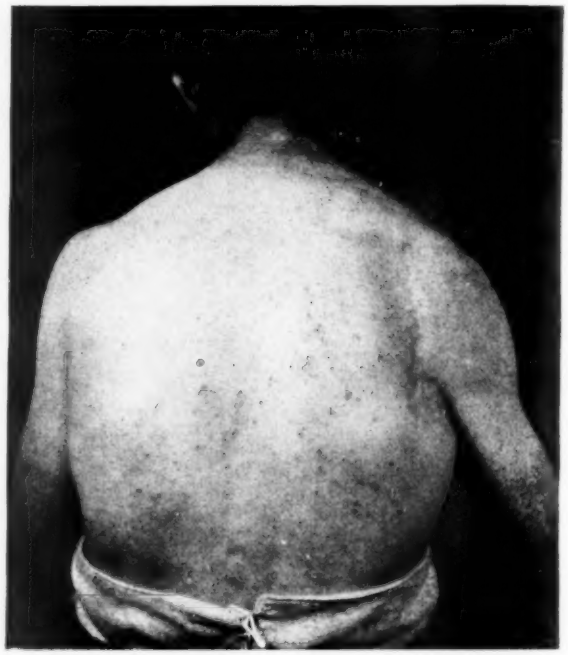

FIG. 11. Case II. Result two years after partial excision. Patient well over six years later.

CASE III. T. K., white male, aged sixty-six years.

Diagnosis: Chondrosarcoma of scapula.

Operation: Subtotal excision of scapula, May 1, 1933.

Pathological Report: Osteogenic chondrosarcoma.

Result: Reported as well, May, 1936.

CASE IV. T. V. D., albino Negro, aged twenty-eight years.

Diagnosis: Chondrosarcoma of scapula.

Operation: Subtotal excision of scapula, April 21, 1934.

Pathological Report: Osteogenic sarcoma.

Result: Died of metastases, April, 1936.

CASE V. A. S., white female, aged thirty-two years.

Diagnosis: Chondromyxosarcoma of scapula, recurrent.

Operation: First subtotal excision of scapula, March 16, 1935. Second recurrence. Second operation: total excision of scapula, August 27, 1935.

Pathological Report: Chondromyxosarcoma.

Result: Examined August 21, 1936, one year after second operation; excellent anatomical and functional results.

TECHNICAL CONSIDERATIONS

The principles to be observed in the operative removal are:

1. Wide excision of the skin and muscles attached to the involved portion of bone;
2. Excision of the involved portion by division with the saw; the Gigli saw has been found useful for this purpose;
3. After removal of the tumor, reconstruction of the shoulder girdle muscles in so far as possible by suturing them to the remainder of the scapula;
4. Prevention of shock by immediate transfusion on the table at the close of the operation;
5. Skin grafting procedures to replace skin defects;
6. Re-education of the muscles, and early use of occupational therapy.

SUMMARY

The operative removal of a part, or the whole of the scapula is discussed, (1) from an historical review and (2) from a study of the cases of scapular tumors in the Memorial Hospital records and in the Bone Sarcoma Registry of the American College of Surgeons.

The treatment of osteogenic tumors of the scapula in these two series is considered separately with reference to late results obtained by various methods employed.

The substitution of subtotal or total excision of the scapula for interscapulothoracic amputation is recommended for a selected group of osteogenic tumors which includes chondromyxosarcoma and osteochondrosarcoma of relatively low grade malignancy; and chondroma and osteochondroma, which though benign are prone to undergo malignant transformation.

Five cases personally treated by these conservative surgical measures are abstracted briefly.

The careful selection of cases suitable for this type of operation is urged, and technical considerations are given.

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SIMPLICITY IN TREATMENT OF FRACTURES OF UPPER END OF HUMERUS*

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FRACTURES of the upper end of the humerus are of unusual interest because of their age distribution occurring most frequently in elderly and adolescent individuals, while young adults escape (Table 1). In youth, with complete epiphyseal separations, reduction is of paramount importance even to the point of open reduction, yet the green stick fracture at the adolescent level with adduction angulation does not require completing the fracture in order to get perfect alinement. With elderly persons an attempt at reduction may not be wise because of the patient's general condition. Thus, when the treatment of fractures in this location must of necessity vary according to the type of patient, it is not surprising that it varies in the hands of different surgeons. Despite the variety of dressings, non-union of shaft fractures here practically never occurs.

TABLE 1
FRACTURES OF UPPER END OF THE HUMERUS

Age, Years	Total	House	O. P. D.	Old Fractures	Pathological Fractures
1–20	33	11	21	0	3
20–45	13	5	8	2	0
45–88	54	34	21	5	1
Total.....	100	50	50	7	4

The teaching of most textbooks has been that fractures of the upper end of the humerus should be treated by carrying the lower fragment to the uncontrollable upper fragment, thus placing the arm in abduction and external rotation. Ghormley and Mroz,[1] reporting from the Mayo clinic, state that fixation in the aeroplane splint is the most valuable form of treatment for these fractures. If reduction can not be obtained they do not hesitate to resort to open reduction as shown by the fact that this was done on one-third of the cases in the reported series of recent fractures of the upper end of the humerus.

Cotton[2] advocates the reduction of these fractures by traction in the Murray-Jones arm splint as the procedure of choice. When reduction is obtained the arm is gradually brought down to the side and the patient becomes ambulatory. Taylor[3] likewise advocates traction in bed. Gilcreest[4] facilitates traction by using a partial body cast as a buttress against which traction may be exerted.

All writers, however, have not been so favorable to the abduction treatment of such fractures. Howard and Eloesser[5] in a report of an experimental and clinical study contended that in the abduction position the adductor muscles make it difficult to obtain or maintain reduction due to the pull on the upper end of the lower fragment. They also maintain that the belief that one has no control of the upper fragment is not correct. They have determined to their own satisfaction that the upper fragment may be controlled by the pull on the long head of the biceps and the untorn portion of the periosteum. Thus reduction may be obtained by traction in line with the body. The arm is dressed with an axillary pad and a sling at the wrist. A muslin swathe confines the arm to the body. The elbow is

* From Service "C" of the Surgical Clinic of the Hospital of the University of Pennsylvania. The cases treated in the Out Patient Department were reviewed through the courtesy of Dr. L. K. Ferguson.

free so that the weight of the arm pulls on the lower fragment. This method of reduction has proved to be very satisfactory in their hands. The method may fail, however, due to the rupture of the long head of the biceps. There were 3 such cases in their series, 2 of which were operated upon and the rupture of the long head of the biceps confirmed.

A B

Fig. 1. Case 1. W. F., male, aged fifty-nine years, fracture five weeks old on admission. Patient poor operative risk; advised against further attempts at reduction; treated by simple fixation at the side. A. Three years after fracture of the upper end of right humerus. *X*-ray shows position. The anteroposterior view gives no additional help. B. The patient is working as a carpenter; subjectively, a perfect functional result; objectively, very slight limitation of abduction.

The belief that the abducted position is undesirable because of the deformity due to the pull of the adductor muscles is also held by Gordon.[6] He, too, uses an axillary pad with a sling and shoulder cap and a swathe around the body. Traction is obtained by suspending weights at the elbow by adhesive straps on the upper arm. At night, traction is applied by a pulley over the foot of the bed.

In a report giving end results of this type of fracture, Sumner Roberts[7] states "compared with ten years ago there has been a marked trend away from prolonged fixation and the position of abduction toward simple fixation and early motion." The majority of comminuted fractures in his series were treated by simple fixation at the side, while only 20 per cent of the transverse fractures were treated in this manner.

The most frequent fracture of the upper fourth of the shaft of the humerus is that at the surgical neck, so termed because of this fact. The type varies from a simple transverse line to bad comminution. Fractures at this site result in the same displacement so constantly that it is spoken of as the typical deformity. This displacement is the direct result of muscle action. The upper fragment is abducted and externally rotated by the short and relatively weak supraspinatus, infraspinatus and teres minor, somewhat opposed by the subscapularis muscles. The lower fragment is the one most displaced from the normal line because a more powerful group of muscles is concerned. This adduction is the result of the pectoralis major, teres major and latissimus dorsi muscles. Shortening follows the action of the biceps, triceps, coracobrachialis and deltoid muscles. Analysis of the foregoing would seem to indicate that the easiest fragment to control should be the upper one, after reduction is accomplished. In order to accomplish reduction the lower fragment often must have sufficient traction applied in the direction of the abducted upper

fragment to obtain end-to-end approximation. However, after the fragments are thus locked or "spiked" together the

If satisfactory results can be obtained by simple fixation, it is obviously a more desirable type of treatment than placing

A B

FIG. 2A. Case II. W. W., male, aged forty-seven years. Fluoroscopic reduction using local anesthesia. Arm dressed with the senior author's abduction cast. *X*-ray shows position. The lateral view gives no additional help. B. Two years after fracture of upper end of right humerus, perfect functional result, both subjectively and objectively.

limb should best be slowly returned to the patient's side and fixed there against an axillary pad. This position relaxes the pull of its pectoral fold muscles and at the same time gives gravity much the best chance to act against the shortening effect of the arm muscles, at least when the patient is upright.

Complete end-to-end reposition is never necessary for union, nor for function in this fracture. Non-union here is extremely rare if it ever occurs. Good function can be obtained with extreme deformities in many instances, as shown by the *x*-ray pictures. In fact it is our belief that better functional results occur in these fractures with mediocre and even bad position of fragments than in any other group of juxta articular fractures in the body. Open reduction is rarely indicated in the adult if function is the main object as it should be.

the arm in the position of abduction and external rotation. Analysis of the cases of fractures of the upper end of the humerus treated by us and herein reported shows that the majority were dressed by simple fixation at the side. It therefore seems worth while to report the method of treatment used as well as the results obtained.

In this clinic fractures of the upper end of the humerus, as fractures elsewhere, are treated as surgical emergencies. Except in cases in which the general condition of the patient contraindicates it, an *x*-ray examination is made upon admission to the hospital. If a reduction is required, it is done immediately, day or night. An early reduction with the least possible trauma is considered an excellent start toward a good result. Multiple attempts at reduction are not countenanced. Accordingly the reduction is attempted with

adequate assistance and anesthesia and with fluoroscopic control.

If the fracture is seen early, local anesthesia is used by preference since a conscious patient in the sitting position facilitates the application of the dressing after the reduction has been accomplished. A muslin swathe is placed around the patient's chest so that one assistant may afford countertraction while another is exerting traction on the abducted arm. The surgeon thus has his hands free to mold the fragments if necessary, or, having fluoroscopic vision, to direct the pull at the proper angle. The two fragments can usually be brought end-to-end in this manner and locked. The use of a procedure similar to the method of Sir Astley Cooper for reduction of a shoulder dislocation, i.e., traction on the extended limb with the unshod foot of the surgeon in the axilla for countertraction, is often successful. The traction on the arm must be decreased so that the two fragments may be impacted or "spiked" by the pull of the muscle. The arm can then be brought down to the side gradually. When the upper fragment will not follow as the arm is adducted, it may be necessary to abduct the arm to the position where the fragments will remain in contact. In fractures at the adolescent level, the arm must obviously be brought to the side since the upper fragment is adducted.

A B

Fig. 3A. Case III. M. C., female, aged forty-nine years. Fluoroscopic reduction using local anesthesia. Arm dressed at the side with axillary pad and body swathe. *X*-ray shows position. The lateral view gives no additional help. B. Three years after fracture of the upper end of left humerus. Subjectively, some discomfort on extreme motion; objectively, perfect functional result.

If under ideal conditions a satisfactory reduction is not obtained it is unlikely that a second effort will improve the result. It is generally agreed that the older the fracture, the more difficult is the reduction. We have been required, therefore, to attempt a second reduction in only 4 cases in this series; 3 of these were unsuccessful so that open operation was necessary.

For the adduction treatment, the usual dressing is made by strapping the arm to the side with adhesive over an axillary pad, a sling at the wrist and with a swathe or adhesive strip around the body and the sling to prevent the forearm swinging out from the body, thus causing rotation of the distal fragment of the humerus.

Very occasionally a plaster-of-Paris short shoulder cap may be added. The elbow is left free in order that gravity may cause some pull on the lower fragment. This traction may be increased by adding weight at the elbow. This may be done very conveniently by molding a lead plate around the lower arm and upper forearm.

A B

Fig. 4a. Case iv. M. R., female, aged sixty years. No attempt at reduction. Arm dressed at the side with axillary pad and swathe around the body. *X*-ray shows position. Lateral view gives no additional help. b. Three years after fracture of the upper end of right humerus. Perfect functional result, both subjectively and objectively.

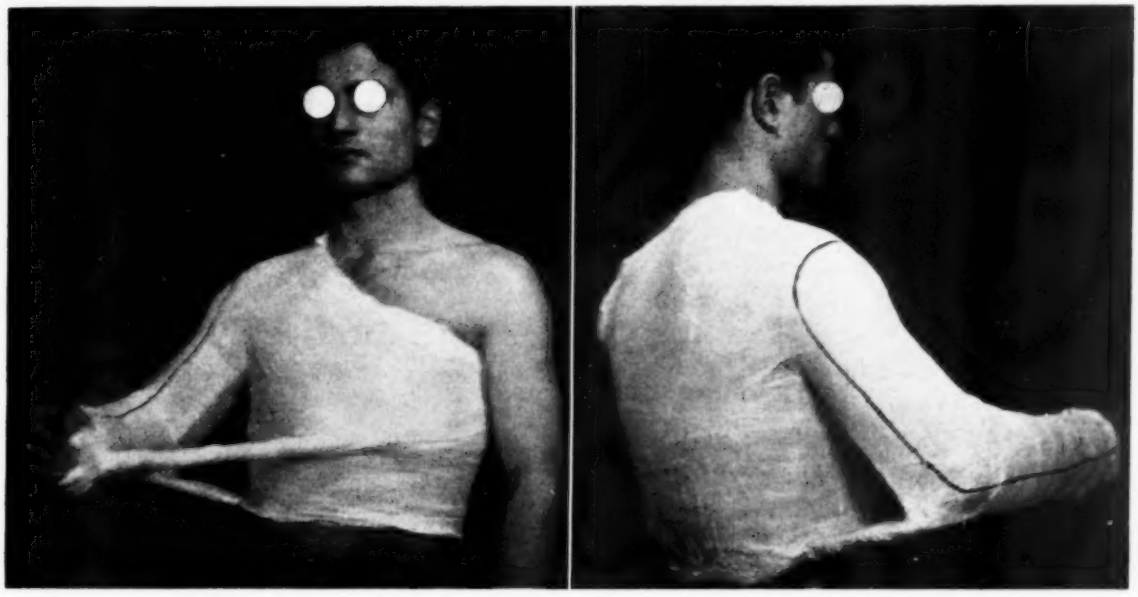
When the abduction treatment is necessary, the senior author's abduction plaster cast is used. This gives from 45° to 90° abduction. The need for more than 45° abduction is unusual. A Mitteldorf triangle with an internal right angle splint on one side forms the basis of the dressing. This is made to fit the arm and padded to make it comfortable. The arm and body with the splint are then encased with plaster. Because of the use of the wood splints, the plaster cast can be made quite light. The strut between the body and wrist adds strength. The cast is cut out so that motion at the shoulder, elbow and wrist may be obtained early.

The reduction is not attempted until an *x*-ray film has been taken. The fracture may be quite obvious under the fluoroscope, but the *x*-rays are taken as a permanent record. After reduction, *x*-rays are taken on the following day. This allows for the return of muscle pull after the anesthesia has worn off and a resultant displacement at the fracture site can be recognized.

There are two groups in the series of cases to be reported: 50 patients treated in the Surgical Out-Patient Department, and an equal number admitted to the hospital. Table i shows that 54 of the patients were over forty-five years of age which factor contributes in no small measure to our desire to dress these patients in simple fixation, if possible. Old and pathological fractures did not constitute an important part of the series.

Table ii shows the type of fixation used in this series. In the group treated as out-patients, reduction was usually easy or not necessary, so that the arm was placed in abduction in only 3 instances. Of those patients admitted to the hospital, only about one-third required the abduction treatment. Open reduction was done in only 5 instances. Traction with the patient in bed was used only twice.

Each fracture is, of course, a problem within itself, but general considerations are nevertheless valuable. In 75 per cent of our series there was a fracture of the surgical neck. Therefore, this is the typical fracture of the upper end of the humerus.



A B

FIG. 5A. The senior author's abduction cast. The foundation is formed by an internal right angle splint on a Mittledorpf triangle which is padded to be made comfortable. It is then incorporated in plaster. Note the strut from hand to body to add strength. Thus the cast can be made quite light. B. The cast is cut out along the black line to allow inspection of the arm and early motion.

TABLE II

Dressing	House			O. P. D.	
	Total	Adult	Children	Adult	Children
Operation	5	2	3		
Abduction cast	18	11	4	1	2
Traction	2	2			
Abduction dressing	64	20	4	27	13
None	4	4			
No record	7	..	..	3	4
Total	100	39	11	31	19

There is a difference, however, in a comminuted fracture and a transverse fracture. The latter cases have more frequently been dressed in a semi-abducted position, whereas the comminuted fractures have usually been treated by simple fixation at the side.

An end-to-end approximation is highly desirable in cases of epiphyseal separations. If this can not be obtained by closed methods, open reduction is usually indicated. It is seldom necessary to use internal fixation.

If reduction cannot be obtained in fractures of the greater tuberosity, it is necessary to place the arm in abduction in order to contact the tuberosity lying under the acromial shelf. These patients may be dressed with the arm at the side, however, unless there is undue separation of the fragments. Open reduction with internal fixation may be indicated when an abduction dressing is contraindicated by a complicating anterior dislocation of the shoulder.

Fractures of the anatomical or surgical neck complicated by dislocation of the head can seldom be reduced by the closed method. In cases of anatomical neck fractures pain is the chief indication for operation with removal of the head, since the functional result is frequently not

improved by this procedure. In surgical neck fractures with dislocation, however, open reduction should be done if necessary and good function can be expected.

The treatment of fractures of the upper end of the humerus varies greatly according to the age, the health and the occupational requisites of the patient. One is often satisfied with simple fixation at the side for a fracture in an elderly individual, whereas with the same fracture in a younger individual an abduction dressing or open reduction might be desirable. A young athlete needs full function, an elderly retired gentleman of leisure can do with much less function, if to obtain more would require punishing treatment. It is much better to accept some limitation of abduction than to attempt to get a perfect reduction in a poor risk patient. When the arm is dressed with simple fixation at the side, one is constantly surprised at the satisfactory functional result even though the upper fragment was abducted. Function is first, restoration of the fragment is second, in importance to the patient.

Shown in the accompanying figures are the *x*-ray pictures of cases in which either no reduction was attempted because of the patient's general condition or in which reduction was so successful by simple manipulation that the arm was dressed at the side without further ado. The general condition in each of these patients was such that the simplest possible type of treatment was desirable, and a general anesthesia was out of the question. Each of these patients obtained a useful arm in spite of the poor *x*-ray appearance. Loss of length does not imply loss of function.

We have been able to follow only 56 cases in this series as to the ultimate result. The ratio of the patients treated by simple fixation at the side to those treated by abduction or operation is about the same in the followed cases as in the entire series. In Table III these cases are grouped as to the type of fracture and the end result. The patients in group "*A*" had a practically perfect functional result. A few had slight limitation in some extreme movements but to all practical purposes had a perfectly normal arm. In group "*B*" are 4 patients who have definite restriction of motion but are able to carry on their daily activities in a normal manner. The chief limitation in motion is in raising the arm above the head. One of these cases was five weeks old when first seen so that no reduction was attempted. Of these 4 patients, 2 were treated with the abduction cast and 2 with simple fixation at the side. The 2 patients in group "*C*" had sufficient limitation to interfere with normal activity. One, the patient with the fracture of the surgical neck and treated by the abduction cast, was unable to comb her hair or fasten her dress in the back when last seen, eight months after injury. The patient with a dislocation and fracture of the surgical neck was not seen by us until eight months after injury. Operation was refused and so reduction of the dislocation was not obtained. One and a half years later she could get 90° abduction.

TABLE III
RESULTS IN FOLLOWED CASES

	Total	*A*	*B*	*C*
Surgical neck	24	21	2	1
Surgical neck and tuberosity	7	7		
Anatomical neck	1	..	1	
Tuberosity	2	1	1	
Tuberosity and dislocation	1	1		
Dislocation and surgical neck	2	1	..	1
Epiphyseal separation	5	5		
Surgical neck in children	14	14		
Total	56	50	4	2

SUMMARY

1. In a series of 100 fractures of the upper end of the humerus seen by us, 89 required and submitted to some type of fixation or operation. Simple fixation at the side was used in 63 cases or 70 per cent, the arm was dressed in abduction in

19 cases or 21 per cent; operation was performed in 5 and traction in bed was used twice.

2. Of 56 patients that were followed, 89.4 per cent had a satisfactory result.

CONCLUSIONS

1. Simple fixation at the side is shown to be a valuable form of treatment in fractures of the upper end of the humerus.

2. It is especially valuable in elderly or debilitated individuals.

3. It was most frequently useful in comminuted fractures.

4. Perfect reduction is not necessary in order to procure desired function.

5. It is better to treat the individual and not the roentgenogram.

6. Deformity does not necessarily mean dysfunction.

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WEAK FOOT: PATHOGENESIS AND TREATMENT

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SUCCESS in the treatment of the common type of weak foot due to poor posture depends upon the intelligent employment by the physician and the patient of five separate but simultaneous lines of attack: (1) maintenance of correct posture; (2) proper use of the foot in walking; (2) exercises for the re-education of foot and leg muscles; (4) properly constructed shoes that fit correctly; and, (5) a temporary crutch in the form of an arch support.

In this discussion the writer has in mind the uncomplicated weak foot. Just as in the treatment of complicated diabetes, there is a basic attack directed always toward the primary distortion of physiology. the derangement of carbohydrate metabolism, and a secondary attack varying in nature with the complication, whether it be a dermatitis, an arterial degeneration or a neuritis; so too in the treatment of the complicated weak foot there is a basic attack directed always toward the primary distortion of physiology, maladaptation of the weight-bearing mechanism to the superstructure, and a secondary attack varying in nature with the complication, whether it be flat foot, small joint arthritis, callous, march foot, synovitis, periostitis, muscle spasm, or any other of the pathological sequels that have for too long been dignified as clinical entities for the nourishment of an army of parasitic specialists.

No matter whether the clinical condition present in a given case is simple weak foot or weak foot complicated by flat foot, etc., the basic attack is the same regardless of variations that must be made in the secondary attack. The intent here is a presentation of the rationale in the attack on the primary distortion of physiology leading to the common type of weak foot, uncomplicated or complicated. The discussion concerns the weak foot per se and not the complications.

POSTURE IN RELATIONSHIP TO PEDAL EFFICIENCY

The superstructure of the body is attached to and hangs from that portion of the spinal column situated above the level of the fourth lumbar vertebra, and it amounts to perhaps two-thirds of the entire body weight. This superstructure includes the cranium and its contents, the shoulder girdle and the upper extremities, the thorax and its contents, and the organs contained in the abdominal cavity. The spinal column in turn rests on the sacral platform, that is, the top of the first sacral vertebra, and this platform is supported by the pelvic girdle and the lower extremities. In a one hundred and fifty pound individual the superstructure represents a load of one hundred pounds on the sacral platform.

This load on the sacrum is transmitted through the iliac bones to the femoral heads in a very definite manner (Fig. 1). When the body is maintained in the erect position so that the full superstructure weight rests on the sacrum, there is compression in the acetabuli about the areas of contact with the femurs, and there is tension at the symphysis. There is compression in the acetabuli because the load is resisted in the opposite direction by the femurs. Tension at the symphysis is the result of the tendency of the pelvic bones to flare as a force is applied to the top of the sacrum. The anterior face of the sacrum is wider than the posterior face and the upper half of the sacrum is anterior to the lower half, the top of the bone being rotated forward on an axis extending through the third sacral vertebra (Figs. 2 and 3). A force

applied to the top of the sacrum pushes the bone downward and forward, thus dragging on the posterior sacroiliac ligaments that are attached to the posterior iliac spines (Fig. 2). This pull on the posterior ligaments causes the iliac bones to rotate about the sacrum as a fulcrum so that the posterior spines approximate each other and the pubic bones separate.

The weight of the superstructure is in this fashion distributed through the pelvic arches to the heads of the femurs in the acetabuli, each femoral head receiving 50 per cent of the weight. The load is received on a femur eccentrically and is distributed to the cylindrical shaft through the trabecular arches in the neck of the bone (Fig. 1). The femoral bases, or condyles, rest directly on the tibial platforms. The mechanical axis of each femur (Fig. 4) forms an angle of 87 degrees with the bilateral horizontal axis of the knee joints.[1] The anatomical femoral axis makes an angle of 81 degrees. Below the knee joint the mechanical axis of the femur forms a supplementary angle of 93 degrees with the horizontal knee joint axis. This axial deviation between femur and tibia represents the normal valgity of the knee joint and is the result of the difference between pelvic width and the distance between the ankle joints. Each tibia is mounted on a pedestal, or foot.

Considered anatomically as a bony structure, the human pedestal is similar to an eccentric tripod, or, in other words, it represents a three legged stand of unequal sides. It is formed by a number of bones that as a unit contact the ground at three points, the base of the calcaneus and the heads of the first and the fifth metatarsals (Fig. 5). The load of the tibial column supporting the superstructure is received on the astragalus which is closer to the base of the calcaneus than to the heads of the metatarsals (Fig. 6). Because of the proximity of the astragalus to the calcaneus, slightly over three-fifths of the load is dissipated fairly directly to the ground posteriorly through the calcaneus while the other two-fifths is

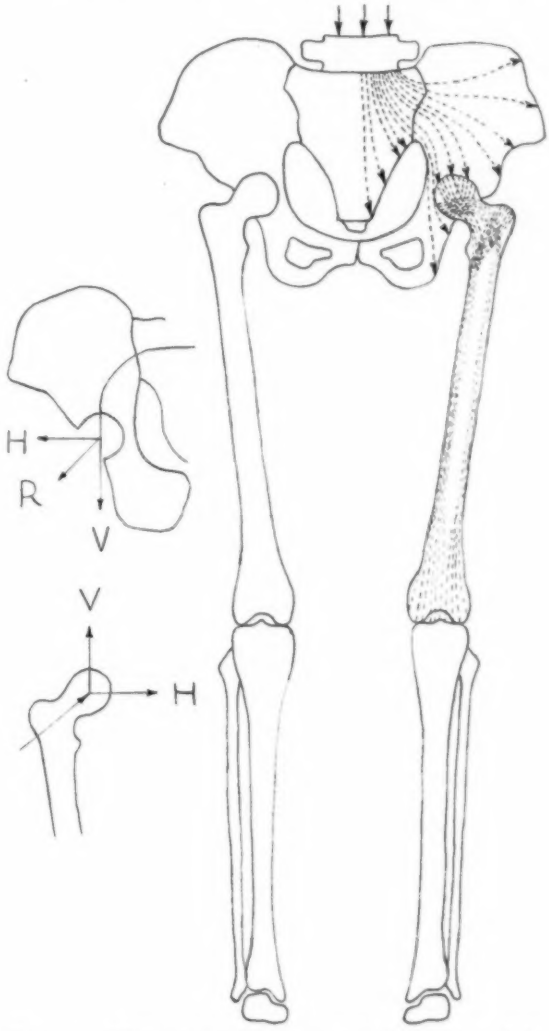

Fig. 1. Diagrammatic representation of weight transmission through the pelvic girdle.

spread anteriorly to the metatarsal heads. Of course, as the line of gravity of the body is shifted forward in walking, the metatarsal heads receive more and more of the load. When the line of gravity falls over the metatarsal heads, the entire load is dissipated to the ground through them.

A static tripod, however, could not serve as the human pedestal because the device used in supporting the body must be an adjustable one in order that it may accommodate itself to the shifting center of gravity of a mobile superstructure, and in order that it may serve as an organ of

[1] Steindler, Arthur. Mechanics of Normal and Pathological Locomotion in Man, Springfield, Ill., Charles C. Thomas, 1935.

locomotion. The foot, in addition to acting as a pedestal, whose function is the dissipation of load to the ground, serves in each step as a spring or as the spring base of a falling body, its purpose being to break the impact of the superstructure of that falling body. Considered physiologically, the foot represents a spring, consisting of a bony framework outlining the major stresses on arches that are maintained by muscles and ligaments in physiological tone (Fig. 7). It is a spring that prevents jarring to the superstructure.

Of the two functions, support of a mobile superstructure and locomotion, the latter is the more complicated, and the features of the pedestal that make locomotion a more efficient function are those that detract from its efficiency in the function of support. The two mechanisms responsible for this spring action are: (1) the eccentrically loaded calcaneus, and (2) the system of resilient arches.

The astragalus does not sit squarely on the top of the calcaneus but rides on a support, the sustentaculum, extending from the inner side of the bone (Fig. 8). A vertical line running through the center of gravity of the astragalus falls to the inner side of a vertical line running through the center of gravity of the calcaneus. The calcaneus is thus eccentrically loaded.

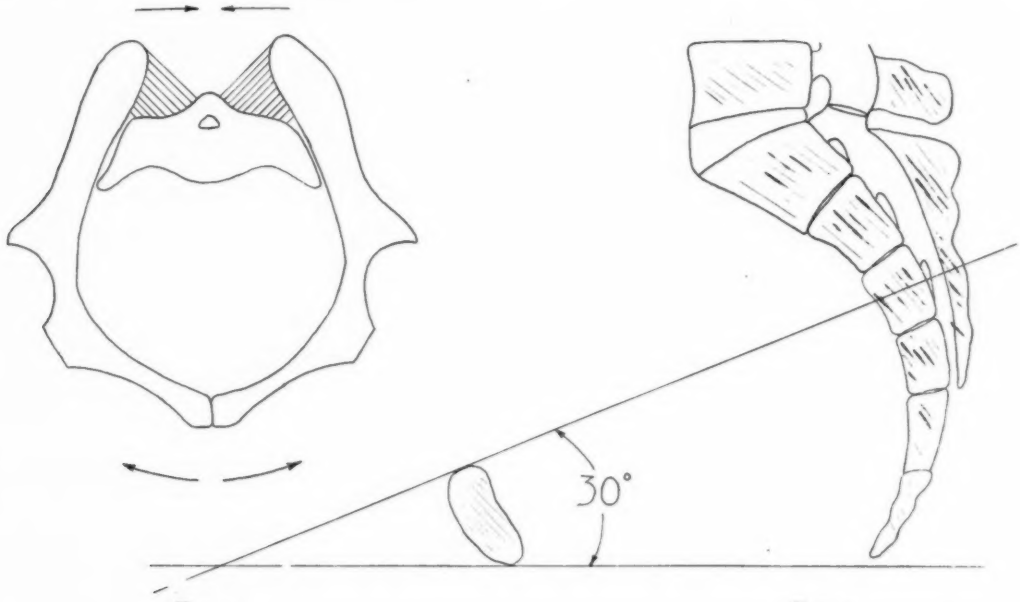

Fig. 2. Fig. 3.

Fig. 2. Diagrammatic representation of a cross section through the adult pelvis. (After Schroeder in Williams' Obstetrics. New York, D. Appleton-Century Co.)

Fig. 3. Diagrammatic representation of a sagittal section through the adult pelvis illustrating pelvic inclination.

For clarity in study, the system of arches in the foot can be reduced to two main stress areas crossing each other. The first of these areas runs anteroposteriorly and centers about the calcaneus, the astragalus, the scaphoid, the cuneiforms and the inner three metatarsals (Fig. 5). For convenience, this area is considered as an imaginary line in the form of an arch, and the line is called the "longitudinal arch" (Fig. 7). The second area crosses the anterior limb of the longitudinal arch and transects the heads of the first and the fifth and the necks of the second, third and fourth metatarsals (Fig. 5). It is called the "anterior arch." The issue of the existence of the anterior arch has been confused[2] by those who apparently have considered the arch as transecting the heads of the second, third and fourth metatarsals, rather than the necks

[2] Morton, Dudley J. Structural factors in static disorders of the foot. *Am. Jour. Surg.*, 9: 315, 1930.

of these bones (Fig. 5). The anterior extremity of the longitudinal arch joins the crown of the anterior arch. Both arches

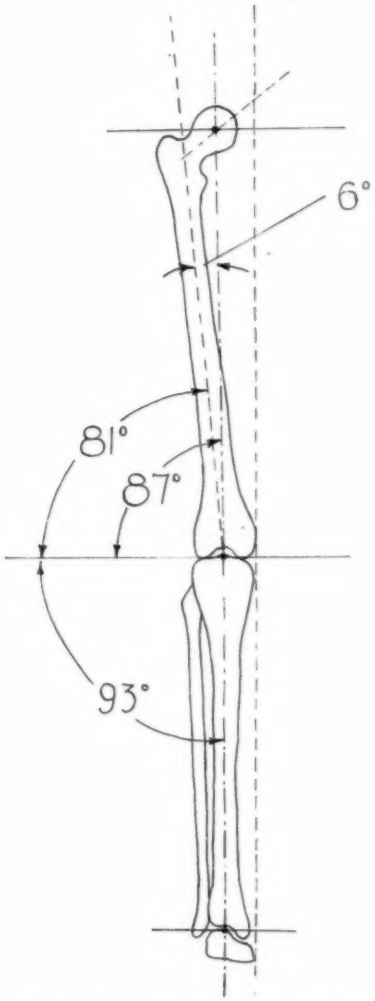

Fig. 4. Orientation and axes of the knee joint; illustrating the anatomical and mechanical axes of the femur, the mechanical axis of the leg and the horizontal knee joint axis. (Steindler, Mechanics of Normal and Pathological Locomotion in Man. Springfield, Ill., Chas. C. Thomas.)

are rampant; that is, the crowns are not equidistant from the bases. The astragalus forms the crown of the longitudinal arch, and the crown of the anterior arch is at the inner edge of the second metatarsal. Load on the posterior extremity of the longitudinal arch is transmitted to the ground through the calcaneus. Load on the anterior extremity of the longitudinal arch is divided between the forward extension of that arch and the anterior arch.

The action of this mechanism in locomotion is as follows: As the lower extremity is moved forward at the hip, the leg is extended at the knee. The center of gravity of the body is shifted anteriorly, causing

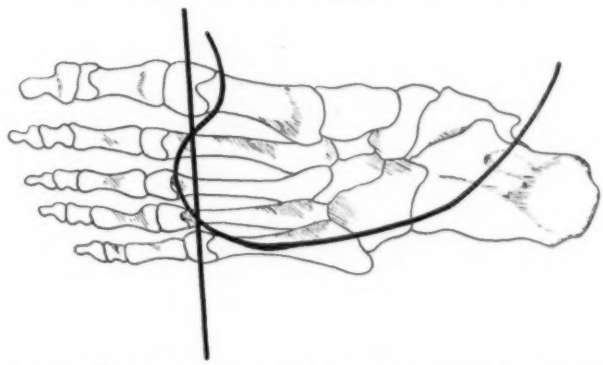

Fig. 5. The skeleton of the foot drawn from the plantar surface. The curved line outlines the inner boundary of the supporting surface; the vertical line illustrates the transection of the necks of the middle metatarsals by the "anterior arch."

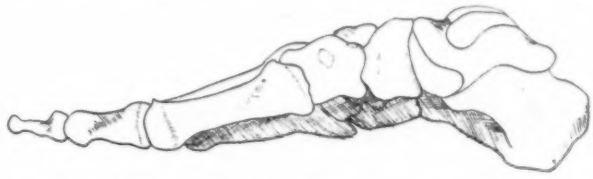

Fig. 6. The skeleton of the foot drawn from the medial aspect.

the body to fall forward. As the heel of the extended lower extremity makes contact with the ground, the weight of the superstructure is received on the head of the femur and is transmitted to the astragalus (Fig. 1). If the full load of the superstructure were transmitted directly to the ground through the heel at this point, the superstructure would be jarred. Such, however, is not the case, for the astragalus, resting eccentrically on the calcaneus, tends to fall (Fig. 9). A considerable part of the impact is broken by this falling of the astragalus. As the center of gravity of the body moves still farther forward, the anterior supports of the tripod, the heads of the metatarsals, contact the ground. At this point there is a second impact. The body weight is shifted anteriorly on the longitudinal arch which now has a contact

with the ground through the anterior arch. The fall of the astragalus is slowed considerably, but there is a continuance of its fall in the bending of the longitudinal arch. If the anterior limb of the longitudinal arch rested on the ground, this bending of the arch would be brought to a sudden stop, the arch would be subjected to considerable strain, and the superstructure would be jarred. The bending, however, is brought to a gradual halt by the give or bend in the anterior arch upon the crown of which the longitudinal arch rests (Fig. 7).

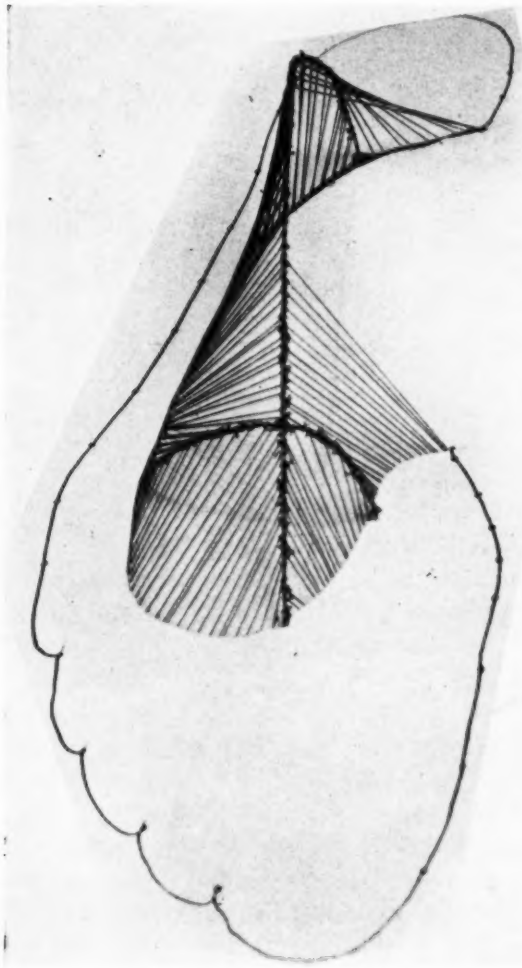

Fig. 7A.

As was noted previously, the device that prevents jar to the superstructure, that is, the eccentrically loaded calcaneus, is the very device that leads to a breakdown of the pedestal in its function of weight bearing.

When the body maintains the erect position and is stationary, there is a tendency for the astragalus to fall, because of its eccentric position on the calcaneus. Since the astragalus forms the crown, or the peak, of the longitudinal arch, the superstructure, resting on the astragalus, rests on the crown of the longitudinal arch, and the arch therefore tends to bend. If it bends too much, there will be strain on the ligaments binding the bones together. This tendency toward bending will be resisted efficiently only when the crown of the arch and the supporting ends of the arch are in the same plane just as a structural steel arch efficiently resists the tendency toward bending produced by a load on its crown only when the crown of the arch and the supporting ends are in the same plane (Fig. 12). The astragalus is the crown of the arch; the base of the calcaneus is the posterior support; and the crown of the anterior arch is the anterior support. These three points will be in the same plane only when the foot is inverted and adducted. When the foot is

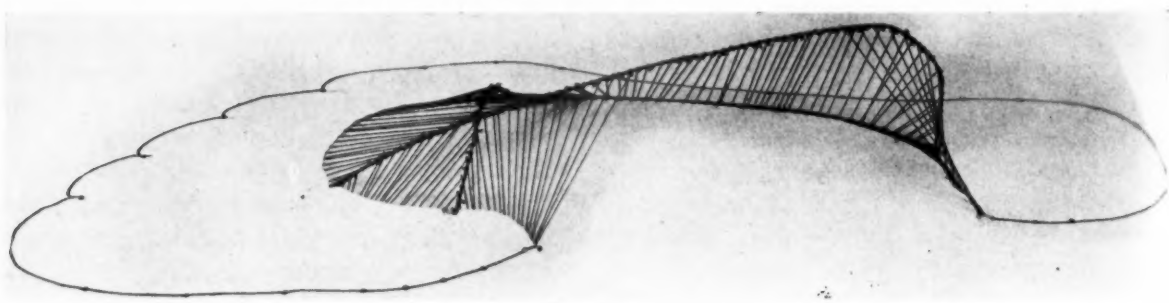

Fig. 7B.

Fig. 7. The pedal "arch" system. The two heavy wires crossing each other represent the imaginary lines that are called the "longitudinal arch" and the "anterior arch." The finer wires outline the inner surface of the supporting system. (Photographs of author's model.)

in the valgus, or abducted position, the anterior limb of the longitudinal arch, that is, the part from the astragalus to the anterior arch, is not in the plane of the posterior limb which is formed by the astragalus and the calcaneus.

The key to an understanding of the mechanical distortion responsible for the weak foot lies in a proper appreciation of the support given to the anterior extremity of the longitudinal arch by the crown of the anterior arch. If the foot is to function efficiently, the anterior support of the longitudinal arch, the crown, and the posterior support, must be in the same plane or, stated differently, the anterior and posterior limbs of the longitudinal arch must lie in the same plane: they must be coplanar. A consideration of the joints and the movements of the foot will show that such a mechanical arrangement is not possible when the foot is in the valgus position.

The two joints of the foot of fundamental importance are the subastragaloid joint with its two subdivisions, and the astragaloscaphoid joint. The subastragaloid joint between the astragalus and the calcaneus comprises two parts, an anteromedial part and a posterior part (Fig. 10). Wiles[3] has described clearly the subastragaloid movement by resolving it into four parts: (1) in movement about a vertical axis the anterior end of the calcaneus moves inward or outward below the head of the astragalus (Fig. 9); (2) in movement about an anteroposterior axis the calcaneus tilts to one side or the other (Fig. 9); (3) in movement about a lateral horizontal axis there is vertical raising or lowering of the head of the calcaneus; (4) in anteroposterior movement there is advancement or retardment of the calcaneus (Fig. 11).

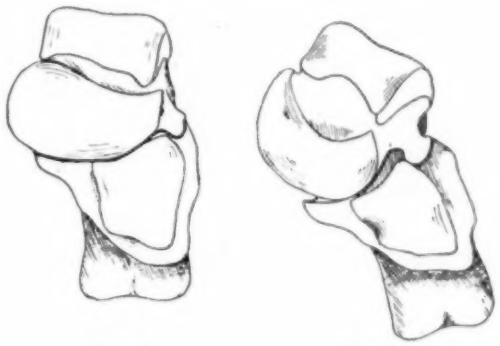

Fig. 8. Fig. 9.

Fig. 8. Anterior view of the astragalus and calcaneus in the normal relationship.

Fig. 9. Showing the head of the astragalus rotated inward and downward and the anterior face of the calcaneus rotated upward and outward.

In the astragaloscaphoid joint there is a considerable degree of motion, both gliding and rotary. This is made possible by the ball and socket construction of the joint and by the enclosing capsule which is loose almost to the point of redundancy.

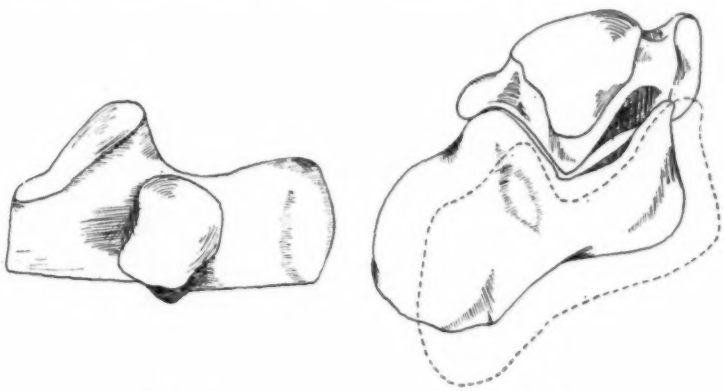

Fig. 10. Fig. 11.

Fig. 10. The upper surface of the calcaneus.

Fig. 11. Lateral view of astragalus and calcaneus. The dotted line represents the calcaneus in its advanced position.

The bones of the forefoot interlock in a very complicated fashion and they are,

[3] Wiles, Philip. Flat feet. *Lancet*, 2: 1089, 1934.

with the exception of those in the big toe, bound together by interosseous ligaments (Fig. 12). For this reason, only the slightest motion is possible in the tarsal or the tarsal metatarsal joints and, from a practical standpoint, the entire forefoot may be considered a mechanical unit working as one piece. The forefoot unit in addition is firmly bound to the calcaneus by the strong ligaments and fascial bands on the plantar surface of the foot, and motion in the joint between the forefoot and the calcaneus, the calcaneocuboid joint, is practically negligible. Since the forefoot is connected with the astragalus by nothing more than the loose astragaloscaphoid joint the whole underfoot, which is practically a unit composed of the forefoot and the calcaneus, moves as one piece about the astragalus.

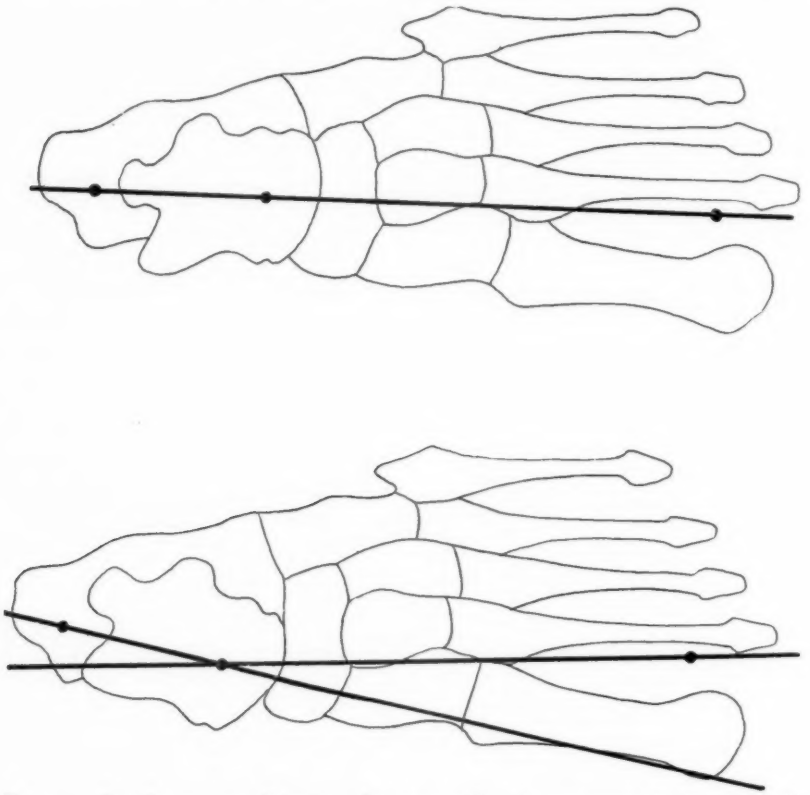

Fig. 12. In the upper diagram the astragalus is represented in external rotation. The center of gravity of the astragalus is in the plane of the anterior and posterior supports of the longitudinal arch. Compare with Figure 7.

In the lower diagram the astragalus is represented in internal rotation. The center of gravity of the astragalus is not in the plane of the anterior and posterior supports of the longitudinal arch.

Because of the close connection between the forefoot and the calcaneus, the movements of the calcaneus about the astragalus are reflected in the forefoot. When the head of the calcaneus moves outward and upward about the horizontal and vertical axes, the forefoot, moving with it, is abducted and pronated. When the head of the calcaneus moves inward and downward, the forefoot is adducted and supinated.

With this summary of pedal movements in mind, the effects on the coplanar arrangement in the longitudinal arch of movements of the underfoot unit (calcaneus-forefoot) about the astragalus are now readily appreciated.

Outward and upward rotation of the head of the calcaneus increases the eccentricity of the astragalus on the calcaneus (Fig. 9). This increase in eccentricity of

the astragalus moves the anterior extension of the plane passing through the centers of gravity of the astragalus and the calcaneus medialward (Fig. 12). The result is that the posterior extremity of the longitudinal arch moves out of the plane of the anterior extremity. The crown of the arch obviously then is not in the plane of the anterior and posterior supports, and the bending of the arch under load on the crown is not resisted efficiently.

A brief reconsideration of the transmission of superstructure load to the femoral heads will bring out how a shift in the center of gravity of the superstructure produces a change in the relation of the astragalus to the calcaneus and to the anterior arch, that is, a change in the relation of the crown of the longitudinal arch to its posterior and anterior supports.

In the normal individual who maintains good posture, the pelvis is inclined to an angle of 30 degrees from the horizontal. The plane of pelvic inclination is taken as one passing across the top of the symphysis and through the third sacral vertebra (Fig. 3). The line of gravity of the superstructure falls through a plane through the anterior halves of the sacroiliac joints and through a plane through the posterior borders of the acetabuli (Fig. 13). The important pelvic girdle platforms receiving load, the sacral platform and the femoral heads, are thus anterior to the line of gravity of the superstructure. The tendency for the pelvis to tilt backward is resisted by the iliofemoral ligaments. Since the line of gravity of the superstructure falls behind the hip sockets, the shafts of the femurs, representing the supporting columns, will be approximated to this line of gravity only when they are behind the hip sockets. They will be in this position only when the heads of the femurs are rotated externally. For this reason slight external rotation of the femurs is consistent with good posture.

In the common type of postural defect due to poor postural habits, the head is dropped down and forward, the shoulders are dropped, the thoracic kyphosis is increased, the abdominal muscles are relaxed, allowing the abdominal organs to fall down and forward, and the lumbar curvature is accentuated. The center of gravity of the body is shifted forward and the load on the sacrum is consequently moved forward. The sacrum as a result rotates about its axis, the pelvis moving with it (Figs. 14 and 15). With this shifting forward of body weight, the line of gravity moves forward and falls in a plane through the anterior borders of the hip sockets. The change thus produced in weight distribution of the superstructure necessitates an adjustment in the supporting femoral columns. They must be moved forward to positions anterior to the hip sockets. This is accomplished by internal rotation of the femurs.

Internal rotation of the thigh is reflected in the ankle. Rotation at the knee joint is possible only when the knee is flexed. It cannot be accomplished when the joint is fully extended. The thigh and leg must therefore move as a unit when the knee joint is extended. At the ankle the horizontal rotary movement is possible only when the foot is plantarflexed completely. Ankle rotation cannot take place when the foot is perpendicular to the leg. It is obvious then that when the individual assumes the erect position, with the knee joint extended and with the foot held at a right angle to the leg, that the femur, the tibia with its attached fibula, and the astragalus must move as a unit.

The effect on the foot of internal rotation of the unit composed of the femur, tibia, and astragalus, is the production of a relative valgus position, because the astragalus, rotating internally, moves inward and downward in relation to the calcaneus. The effect on the astragaloforefoot relationship of this movement of the astragalus, about the calcaneus is the same as that of an outward and upward movement of the calcaneus about the astragalus because the calcaneus and forefoot move as a unit. It produces a valgus relation between the forefoot and the astragalus (Fig. 12).

VALGUS RELATION

The earliest distortion in the foot then is the valgus relation between the astragalus and the underfoot, the underfoot being taken as the calcaneus-forefoot unit. Improper posturing of superstructure musculature allows a sagging and shifting forward of the spinal column. Load on the sacral platform is thus distributed more anteriorly, and the bone as a result rotates about an axis extending through the third sacral vertebra. The pelvis, being firmly attached to the sacrum, rotates with it so that pelvic tilt is increased. Internal rotation of the femurs now brings these supporting columns into the plane of the anteriorly shifted line of gravity of the superstructure. Internal astragalar rotation follows and the result is the valgus relation in the feet.

The adducted plantigrade position of the normal foot is maintained by several groups of posturing muscles. When a normal body is at rest in the erect position, the various bones of the skeleton, bound together by ligaments and the articular processes of the bones themselves, are maintained in positions of comfort and efficiency by posturing muscles. Maximum efficiency in the posturing of any group of bones forming the skeleton is the result of perfect balance between antagonistic and synergistic muscle groups that are in a state of physiological tone. Maximum efficiency in weight bearing does not allow of the constant subjection to strain of any ligaments and it

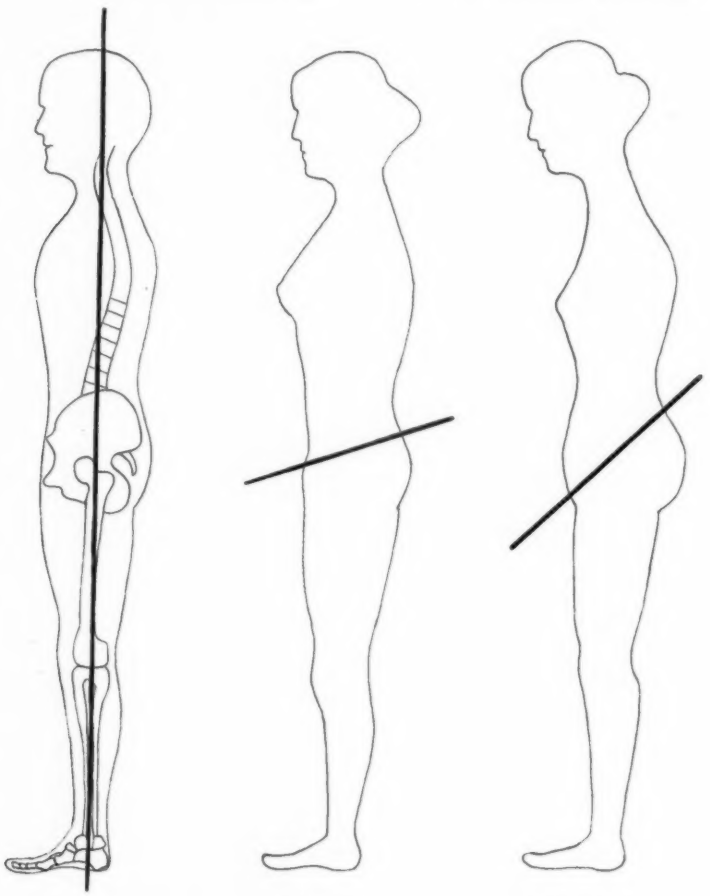

FIG. 13. FIG. 14. FIG. 15.

FIG. 13. Illustrating how the line of gravity of the superstructure falls through the plane of the posterior borders of the acetabuli.
FIG. 14. Correct posture with the pelvis inclined to 30 degrees.
FIG. 15. Poor posture with pelvic inclination increased.

does not allow of prolonged maintenance of contraction in any muscle or muscle group. Wiles has pointed out that the posture of the foot is dependent on the positions of its intrinsic joints. He has emphasized that body weight or superstructure load is transmitted from one bone to the next in the pelvis, in the thigh, in the leg, and in the foot, and that the positions of the various joints in the foot are "altered by active muscular contraction and maintained by the tone of the posturing muscles."[3]

The valgus relation between the astragalus and the underfoot, the result of faulty posturing of superstructure musculature, disturbs the balance in the foot posturing muscles and it is the strain of the extra load thrown on one group of these muscles that is behind the clinical manifestations of the condition known as weak foot.

An individual analysis of the major foot posturing muscles follows.

The M. tibialis anterior is a superficial muscle on the anterior surface of the leg arising from the lateral condyle and the lateral surface of the tibia and from the crural interosseous membrane. The fibers converge downward to a flat tendon that crosses the ankle joint anteriorly and drops over the inner side of the foot to be inserted into the medial and undersurfaces of the base of the first metatarsal and the first cuneiform bone. The muscle dorsiflexes the whole foot and elevates the first metatarsal base and the first cuneiform.

The M. extensor hallucis longus arises from the anterior surface of the fibula and from the crural interosseous membrane, crosses the ankle joint anteriorly in a special compartment, and runs along the dorsal surface of the great toe to gain its insertion in the base of the proximal phalanx. It dorsiflexes the foot and the first toe.

The M. extensor digitorum longus arises from the lateral condyle of the tibia, the upper portion of the fibula and from the crural interosseous membrane. Its tendon terminates in four divisions that are inserted into the second and third phalanges of the four outer toes. The muscle dorsiflexes and pronates (everts) the foot.

The M. peroneus tertius arising from the fibula and being inserted into the dorsal surface of the base of the fifth metatarsal is a part of the M. extensor digitorum longus.

The M. gastrocnemius, M. soleus, and M. plantaris take origin from the posterior surfaces of the femur, tibia and fibula and unite to form a common tendon, the tendocalcaneus, that is inserted into the middle part of the posterior surface of the calcaneus. They flex the leg and the foot, and supinate (invert) the foot.

The M. flexor hallucis longus arises from the lower two-thirds of the posterior surface of the fibula and from surrounding fascia. The fibers converge to a tendon that lies in a groove crossing the posterior surface of the lower end of the tibia, the posterior surface of the astragalus, and the undersurface of the sustentaculum tali. The tendon passes forward to its insertion in the undersurface of the base of the first phalanx of the great toe. Its action is plantarflexion, supination (inversion) of the foot, and plantarflexion of the first toe.

The M. flexor digitorum longus situated on the inner side of the leg arises from the posterior surface of the tibia. The fibers end in a tendon that passes behind the medial malleolus and into the plantar surface of the foot where it divides into four slips that are inserted into the terminal phalanges of the lesser toes. The muscle plantarflexes and supinates (inverts) the foot and flexes the lesser toes plantarward.

The M. tibialis posterior arises from the posterior surface of the tibia and fibula and the crural interosseous membrane. Its tendon runs in a groove on the back of the medial malleolus and to the plantar surface of the foot where it is inserted into the scaphoid, the sustentaculum tali of the calcaneus, the cuneiforms, the cuboid and the bases of the second, third and fourth metatarsals. This muscle plantarflexes and supinates (inverts) the foot.

The M. peroneus longus situated on the lateral side of the leg arises from the lateral surface of the fibula. Its tendon runs in a groove on the posterior surface of the external malleolus and bends under the cuboid bone in a groove to gain the undersurface of the foot. After crossing the plantar surface of the foot the tendon is inserted into the lateral and undersurfaces of the inner cuneiform and the base of the first metatarsal. The muscle flexes the foot plantarward, pronates and abducts it. It pulls the big toe to the ground.

The M. peroneus brevis arises from the lower two-thirds of the lateral surface of the fibula beneath the peroneus longus. The fibers end in a tendon that runs in a groove on the posterior surface of the external malleolus to be inserted into the lateral surface of the base of the fifth metatarsal. Its action is plantarflexion and pronation (eversion) of the foot.

The muscles considered individually in the foregoing section may be grouped as follows:

Group I Muscles. M. tibialis anterior, M. peroneus tertius, M. extensor digitorum longus, and M. extensor hallucis longus.

These muscles dorsiflex the foot at the ankle joint. The M. tibialis anterior in addition elevates the inner border of the foot (supination). The M. peroneus tertius in addition when working with the peroneus longus elevates the outer border of the foot (pronation).

Group II Muscles. M. gastrocnemius, M. soleus, and M. plantaris.

These are powerful plantarflexors. They lift the heel from the ground in locomotion.

Group III Muscles. M. tibialis posterior, M. flexor hallucis longus, and M. flexor digitorum longus.

These muscles are supinators and plantarflexors.

Group IV Muscles. M. peroneus longus and M. peroneus brevis.

These two muscles are pronators and plantarflexors. The M. peroneus longus pulls the big toe toward the ground.

The posturing actions of these muscles when the body is erect are clearly illustrated by shifting the superstructure without changing the positions of the feet. In these functions the fixed point of a muscle is its insertion in the foot, the action being a pull on the supporting tibial column from the foot. When the body leans forward, the muscles in Groups II, III and IV exert a backward pull on the tibiae. When the body leans backward, the Group I muscles exert forward traction on the tibiae. It is quite apparent that the Groups II, III and IV muscles together are much more powerful than the Group I muscles, for the body can lean forward much farther than backward if the superstructure remains straight. If the body is supported on one foot and leans to the unsupported side, lateral traction is exerted on the supporting tibia by the M. peroneus longus. If the body now leans toward the supported side, medial traction is exerted by the M. tibialis posterior.

While there are many minor foot movements, such as toe flexion, adduction or abduction, and while there are many intermediate movements, such as the countless combinations of plantarflexion and supination or dorsiflexion and supination, there are only four major foot movements: (1) plantarflexion and (2) dorsiflexion through the ankle joint and (3) supination or inversion and (4) pronation or eversion through the subastragaloid and astragaloscaphoid joints. Group I muscles are the chief dorsiflexors and the muscles in Groups II and III are the chief plantarflexors. The M. tibialis posterior is the major supinator while the M. peroneus longus is the major pronator. Individual muscles take part in many different movements but each muscle has only one of four major functions: dorsiflexion, plantarflexion, supination or pronation.

Perfect foot posturing then is the result of muscular balancing. The bones of the foot are moved by the antagonistic and synergistic contractions of these muscles into positions that favor the transmission

of superstructure weight from bone to bone with maximum architectural efficiency and bodily comfort. The bones are maintained in these positions by the same muscles in a state of physiological tone.

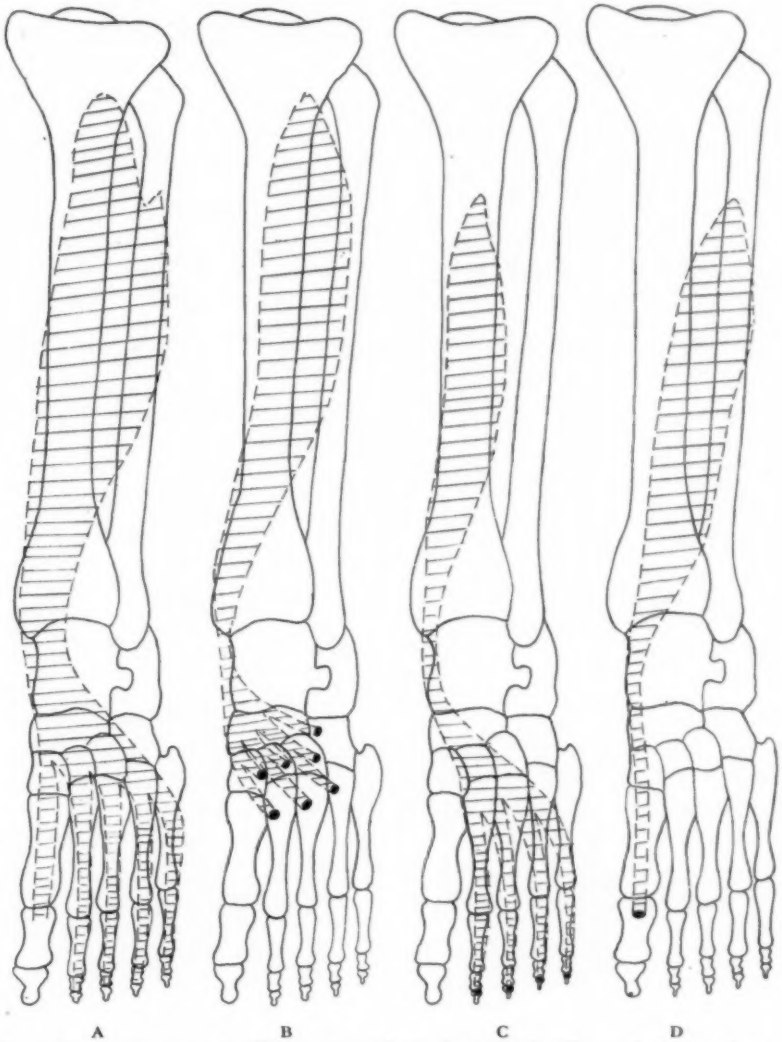

Fig. 16. Diagrammatic illustration of the hammock effect of the tendons crossing the inner side of the foot: A, composite of B, the M. tibialis posterior, C, the M. flexor digitorum longus, and D, the M. flexor hallucis longus. (Whitman, Orthopaedic Surgery, Phila., Lea and Febiger.)

How, then, is the balance in these foot posturing muscles upset by the valgus relationship between the astragalus and the underfoot (calcaneus-forefoot)? Valgus relation (the relative valgus position) leads directly to a loss of tone in the foot supinating muscles, those in Group III. Loss of tone in the Group III muscles follows their assumption of the burden of supporting the astragalus and the inner side of the foot, that is, the crown of the longitudinal arch.

It has been shown (vide supra) that internal rotation of the astragalus increases the eccentricity of that bone on the calcaneus. With this increased eccentricity there is a consequent increased tendency toward falling of the astragalus which means increased bending of the longitudinal arch because the crown of the arch, that is, the astragalus, and its anterior and posterior supports are not in the same plane.

In this relative valgus position with the eccentricity of the astragalus increased, the crown of the arch, being out of the plane

of its anterior and posterior supports, is architecturally incapable of efficiently carrying load. In the very beginning of the valgus relationship part of the burden of holding together this architecturally inefficient structure is borne by the ligaments. However, they do not stand the strain and the astragalus turns farther inward and falls farther down.

The burden is then assumed by the Group III muscles. Figure 16 illustrates how these muscles form a hammock for the astragalar head, the sustentaculum (the astragalar support) and the inner side of the foot. To carry this load the Group III muscles must be in a state of active contraction. Tonal balance between them and their antagnostic muscles (Groups I and IV) will no longer hold the foot in position, the Group III muscles being at an architectural disadvantage.

Thus in maintaining the foot in a position of rest in standing, the Group III muscles must remain in a state of activity or contraction. Such a situation is distinctly not physiological.

This is the weak foot, the valgus relationship between the astragalus and the underfoot. Poor superstructure posturing shifts the center of gravity of the body anteriorly. The shift forward is followed by internal femoral rotation. The astragalus, moving with the femoral-tibial unit, rotates internally. The eccentricity of the astragalus on the calcaneus is increased by this movement of internal rotation and the astragalus, forming the crown of the longitudinal arch, is moved out of the plane of its anterior and posterior supports, the calcaneus and the crown of the anterior arch. The crown of the arch falls (that is, the architecturally inefficient arch bends) under the load of the superstructure. The burden of supporting the astragalus is taken over in part by the hammock muscles in Group III. The active contraction thus made necessary in the Group III muscles destroys the balance of foot posturing.

VALGUS POSITION

The changes described constitute the physiological distortion leading to the weak foot, valgus relation. Valgus position (pronated foot) is the first major complication of the weak foot and is followed in a variable period of time by flat foot, callous (corn), muscle spasm, synovitis, periostitis, arthritis and rigid foot.

Valgus relation produces valgus position or pronation because of the tilting of the calcaneus. The increase in eccentricity of the astragalus throws the superstructure weight farther medialward on the supporting shelf of the calcaneus, the sustentaculum. This tilts the calcaneus; the outer border of its base is lifted, the upper inner edge is pulled medially, and the head rotates outward and upward (Fig. 9). In other words, the head of the calcaneus moves outward and upward through the vertical and horizontal axes. The forefoot, firmly attached to the calcaneus-forefoot unit, follows this movement of the calcaneus; it is abducted or pronated. The weight bearing line in locomotion is then thrown out completely. Further discussion of complications is purposely avoided.

DIAGNOSIS

The subject of diagnosis is passed with a warning note. Physiological and anatomical diagnoses are as important in the simple and complicated weak foot as they are in heart disease or biliary tract disease. Diagnosis in heart disease differentiates causes, e.g., rheumatic and syphilitic; determines anatomical changes, e.g., enlargement of the organ and the state of the valves; and it estimates physiological status, e.g., auricular fibrillation and decompensation. The proper evaluation of biliary tract stagnation in any given patient must include a differentiation of causes, e.g., stone or dyskinesia of the choledochoduodenal barrier; it must take into consideration the anatomical changes in the tract, e.g., cholecystitis, cholangitis, liver cirrhosis; and it must include a physiological esti-

mate based on various functional studies, such as the gall-bladder dye and galactose tests.

A diagnosis in pedal locomotor abnormalities must include cause, physiological distortion, anatomical change and the degree of impairment of function.

While the common and, in fact, the usual cause of weak feet is the anteriorly shifted center of gravity of the body resulting from poor postural habits (slouch posture), it must be borne in mind that many other conditions such as anterior poliomyelitis, arthitic disturbances, injuries and structural abnormalities may underlie maladaptation of the weight bearing mechanism to the superstructure, and the possibility of the presence of these conditions must be eliminated before the pedal disturbance is laid at the foot of poor posture.

An estimation of physiological distortion must take into account functional kyphosis and lordosis, pelvic tilt, femoral and astragalar rotation, calcaneal tilt, the degree of pronation, muscle spasm, and, last and least, the degree of depression of the pedal system of arches.

Anatomical changes include synovitis, arthritis, periostitis, skin changes, and the structural bone changes that occur in accordance with Wolff's law, "Every change in the form and function of the bones or of their function alone is followed by certain definite changes in their internal architecture, and equally definite secondary alterations of their external conformation, in accordance with mathematical laws."

TREATMENT

In the foregoing paragraphs the pathogenesis of the weak foot has been presented. Assuming valgus relation (weak foot) to be the physiological upset that leads to rigid foot, callous, etc., the primary treatment of these conditions must aim at the correction of valgus relation. Readaptation of the weight bearing mechanism to the superstructure must be the starting point in the treatment of the weak foot or any of its complications, just as metabolic readjustment with diet is the starting point in the treatment of diabetes mellitus and its complications, or as immunologic readjustment with diphtheria antitoxin is the starting point in the treatment of diphtheria and its complications. It is with this phase of treatment alone, the basic attack upon which the treatment of any complication of the weak foot is built, that the author is here concerned.

Treatment, if it is to be successful, must include five separate methods of approach to the pathological physiology here presented and all five of these approaches must be made simultaneously.

Any one of the five therapeutic factors under consideration: postural correction, correct usage of the feet, exercises, proper shoes and arch supports, will bring considerable relief to the patient suffering with weak feet, but no one of them employed singly will effect a cure and thereby give complete relief. The great majority of foot sufferers have gone from one surgeon to the next, from the surgeon to the chiropodist, to the osteopath, the chiropractor, and the shoe salesman, only to conclude that nobody had a cure for aching feet. Each of these individuals perhaps gave the patient some temporary comfort because he employed one or even two or three of of the five factors to be considered, but no one of them cured the patient because the five elements of treatment were not employed simultaneously.

These five therapeutic factors, then, postural correction, correct usage of the feet, exercises, proper shoes and arch supports must be employed simultaneously.

MAINTENANCE OF CORRECT POSTURE

Correct body posture implies that the bones of the skeleton to which the soft tissues are attached are maintained in positions of maximum comfort subjectively and maximum architectural efficiency (weight transmission) objectively by a minimum of muscular effort.

Certain fairly constant spinal curves center about the line of gravity of the body

in the normal adult. The convexities of the cervical and lumbar curves and the concavities of the thoracic and sacral curves are forward. These curves do not exist in the newborn. It is not until the infant begins to hold its head erect in the fourth or fifth month that the forward curve of the cervical vertebras appears. After the seventh or eighth month, when the infant first sits alone, the upper thoracic kyphosis is produced. Changes in the lumbar spine begin with weight bearing in the second year and progress throughout childhood. The body is held in the erect standing position when the resistance of the iliopsoas group of muscles is overcome by the erector spinae muscles. Pelvic tilt and the normal lumbar curve are produced by the antagonistic actions of these two muscular groups.

The normal cervical curve is obliterated when the head drops forward. When the head is held correctly, that is, up and back, a line between the inferior margin of the orbit and the external auditory meatus, or roughly, a line dividing the zygoma, is on the horizontal.

If the shoulders are allowed to fall forward, thoracic kyphosis is increased. It is only when the head and shoulders are held up and back that the S-configuration of the cervical and thoracic vertebras will be normal. The normal relation of the thoracic vertebras, present when the shoulders are up and back, allows the chest to expand more freely. The close connection between adequate chest expansion and good thoracic and shoulder girdle posture is demonstrated when one expands the chest in deep inspiration. In this movement the shoulders are thrown up, back, and out. When the head is erect and the shoulders are dropped, both the cervical and the thoracic curves are accentuated. When the head drops with the shoulders, the cervical curve is forward and the vertebras from the lumbar region to the axis form one long curve.

The normal degree of forward curvature of the lumbar spine is greatly dependent upon the backward curve of the thoracic vertebras. Thoracic kyphosis (increased curvature) diminishes thoracic capacity, the decrease in capacity being greatest in the upper thorax. Thoracic space is gained by a lowering of the diaphragm. Lowering of the diaphragm together with wider diaphragmatic excursion, which is the necessary consequence of kyphotic interference with rib motion, decreases abdominal capacity. The encroachment upon abdominal capacity is easily remedied because the abdominal muscles bridging a shorter gap between the lower ribs and the pelvis merely bulge forward. Lumbar lordosis, then, is the result of several combining factors; shifting forward of the center of gravity of the body, encroachment upon abdominal capacity and the drag of the downwardly and forwardly displaced abdominal organs.

The opposing curves of the lumbar vertebras and the sacrum bear a definite relationship to each other. When the lumbar curve becomes more acute (lordosis), the superstructure load carried by the lumbar vertebras is shifted anteriorly on the sacral platform and the sacrum, carrying with it the pelvis is tilted.

Determination of the degree of pelvic inclination is perhaps the most important single factor in estimating the postural habits of an individual. Many patients with maladaptation of the supporting mechanism appear to maintain good posture and in them foot discomfort at first is apparently not dependent upon poor bodily posture. These patients hold their heads correctly and keep their shoulders well back. Some of them even walk and stand with their feet pointing straight ahead. However, further examination usually reveals increased pelvic inclination and lumbar lordosis. These are the patients with poor posture who have heeded the constant admonitions of their friends and relatives that they are getting "stooped over" and "round shouldered." They have raised their heads and shoulders and some of them have even "pulled in their stomachs," but they "haven't pulled in" their buttocks by rais-

ing their pelves. When the buttocks protrude, pelvic inclination is increased.

The femurs must be rotated externally if they are to approximate the line of gravity of the body. External femoral rotation is essential to good posture. The feet must be supinated, that is, they must point straight ahead.

Since most of these patients are adults, it is best to spend some time in showing them what correct posture is. If the various elements of good posture are clearly demonstrated, it is very easy for the patient to remember one or two simple exercises in connection with each phase of posture and to run through different ones during odd moments at work. The entire series of exercises should be performed at least twice a day, night and morning.

If the patient can be made "posture conscious," any form of light general exercise will be a help in maintaining good posture. Walking is available to anyone and is one of the best forms of general exercise. However, unless a definite amount of walking, two, three or six miles, is prescribed for each daily stretch, the patient will not walk.

In demonstrating good posture the patient is asked to stand with his back against a wall, with heels, the calves of the legs, the buttocks, the shoulders and the head, touching the wall. If the patient then places his hand between the small of his back and the wall, he will readily appreciate the large space made by the abnormal lumbar curvature. If he now pushes the small of his back against his hand, he can feel the pelvis rising. In this attitude he should walk away from the wall and around the room. A return to the original position against the wall will reveal whether or not the position has been altered in the walk around the room. In running through the series of exercises this maneuver is repeated five times. Nothing serves better than this to impress pelvic inclination upon the patient's mind. A similar exercise is that of lying face upward on the floor with the knees flexed so that the heels touch the buttocks. The object here is to push the small of the back into the floor. The patient alternately pushes the small of the back into the floor, and relaxes, twenty times.

For the cervical muscles there is no better exercise than the circular or rotary stretching of the tilted head and neck with the muscles on the upward side tense.

The shoulders may be stretched by the common arm extending exercise; ahead, to the side, and to the back. These movements are accompanied by deep breathing. A very light shoulder strap looping over both shoulders in front and fastening to a ring or buckle between the scapulas behind is always helpful and often it is necessary. In large breasted, round shouldered girls at puberty this strap is very important and should be used in conjunction with a light uplift brassiere that elevates the breasts. The psychological effect of rapid development of the breasts at puberty often leads to a dropping forward of the shoulders. The normal response is opposite to this.

Forward bending, with the knees extended, and leg raising, while in the supine position, strengthen the abdominal muscles. Special attention should be given to this exercise because of the close connection between abdominal muscle tone, pelvic inclination and lumbar curvature.

In men, change from a belt to suspenders for supporting the trousers is of definite benefit. When the individual wears a tight belt, there is a very marked tendency to let the abdomen rest on the belt so that the abdominal muscles consequently are not used for support. The belt supporting the abdominal wall drags on the lumbar vertebras and thereby causes an increase in lumbar curvature. The absence of any artificial abdominal support in those wearing suspenders necessitates the use of the abdominal musculature.

The effect of the female girdle is pernicious. The same girdle that enhances the symmetry of the female form in the robed state is the very factor that is responsible for the "pot belly" of the disrobed form, a condition attaining such prevalence in

younger women as to assume the proportions of a secondary sexual characteristic. Prominence of the lower abdomen in the female is normal, but the "pot belly" is not.

Postural correction in the patient then depends firstly, upon instilling into him an adequate conception of correct posture and secondly, upon exercises that will increase the tone of posturing muscles. The exercises outlined in the foregoing paragraphs are listed with those for the feet to make one complete set of exercises.

CORRECT USE OF FOOT

If body weight is to be carried efficiently on the longitudinal arch, the crown of the arch and its anterior and posterior supports must be in the same plane. These conditions will be satisfied roughly from the clinical point of view when the inner edge of the second toe, the head of the astragalus and the base of the calcaneus are in the same line, with the foot adducted, that is, pointing straight ahead, and the astragalus externally rotated. Voluntarily throwing the weight on the outer edge of the adducted foot causes external rotation of the astragalus. This can be demonstrated very simply by having the patient grasp his leg and rotate it outward; he feels the weight shift to the outer side of the foot and he sees the bulge beneath the inner side of his ankle disappear.

It is obvious that in addition to adduction and external astragalar rotation, both supports of the anterior arch, namely, the first and fifth metatarsal heads, must be on the ground. Concentration of weight on the outer side of the foot places the fifth metatarsal head on the ground. At the same time, however, this tends to lift the first metatarsal. Wiles[3] has described a most valuable exercise for teaching the patient to adduct the foot, externally rotate the astragalus and push the first and fifth metatarsal heads into the ground, all at the same time. This exercise which is given below, I refer to as the "chair maneuver."

The patient sits on a chair with the foot on the ground and with the leg below the knee vertical. His leg is then held just above the ankle by the physician. This prevents leg movement. A mark is made on the floor about an inch and a half internal to the first metatarsal head and the patient moves the front part of the foot to the mark. It is important that only the front part of the foot be moved. The big toe is then depressed so that the skin beneath the metatarsal head touches the floor. The foot is then in its proper position. These movements of metatarsal depression and elevation are repeated until the patient is able to perform them without any leg motion. At first the metatarsal head is depressed only feebly because of the difficulty in inhibiting the action of the M. tibialis anterior. In practice the patient should place two fingers on the outer side of the lower third of the leg so that he can feel the peroneal muscles contract when he depresses the first metatarsal. After a little time it is possible to raise and lower the first toe in this position without moving the rest of the foot.

The same principles can be brought out in another maneuver in which the patient walks very slowly across the room steadying the laterally extended arm against the wall. The heel is touched to the ground with the foot adducted and the body is moved forward with the weight on the outer side of the foot. With the weight still on the outer side of the foot the first metatarsal is depressed and the body rises on the toes with a spring. The walking is continued in this manner while the patient concentrates on "heel, outer side of foot, big toe, and spring." This maneuver impresses upon the patient the lever function of the foot.

It is at first difficult for the patient to maintain the correct posture of the feet constantly for the reason that a conscious effort is required. However, unconscious postural control must be preceded by a stage of posture consciousness. Exercises and postural aids, such as the "wall maneuver" and the

"chair maneuver," help to make the individual posture conscious. When a patient begins to take notice of the very large percentage of people walking on the streets with their feet in the valgus position and with their buttocks sticking out behind, he is becoming posture conscious. He more frequently notices his own faulty posture and corrects it. He soon learns to correct his own posture when he feels the tired and heavy sensation in his feet. Correction of posture with the onset of the heavy sensation in the feet soon becomes involuntary and practically reflex.

EXERCISES

Foot and leg exercises serve several purposes: they strengthen the plantar flexors and the adductors so that these muscles can efficiently serve their lever function in walking; they act in conjunction with the postural aids in creating involuntary control of posture; and they stretch the pronators and dorsiflexors.

In walking, the body is pulled over the metatarsal heads by the plantarflexors, the metatarsal heads representing a fulcrum and the plantarflexors the power. Since the first metatarsal bone is longer than the fifth, the metatarsal fulcrum will be perpendicular to the line of progression only when the foot is inverted, for inversion in effect pushes the fifth metatarsal forward. For this reason the body is raised correctly on the metatarsal fulcrum only when the supinators pull the forefoot inwardly at the termination of a step. The weight line should pass through the center of the knee and ankle joints and extend across the inner edge of the second toe.

Raising the body on the toes strengthens the plantarflexors. In order that the supinators may be brought into action, tiptoeing should be accompanied by a rolling out onto the outer sides of the feet. The foot exercises then should aim at rising on the toes and rolling to the sides of the feet.

In all of these exercises the patient gets the feel of correct foot posture and at the same time the pronators and dorsiflexors are stretched.

Patients find that they can run through many of the exercises listed below at odd intervals during the day, and this is advisable. However, the complete set of exercises should be performed twice daily. It is often difficult at first for patients to go through some of these maneuvers barefooted but they should strive to do this as quickly as possible.

INSTRUCTIONS FOR PATIENTS

Standing:

1. Head up, shoulders back, abdomen in, pelvis up;
2. Feet four inches apart;
3. Toes pointing straight ahead;
4. Weight on outer edges of feet;
5. Arches cupped, like palm of hand.

Walking: Take a two mile stretch daily, preferably at noon. This does not include walking while at work. Keep in mind:

1. Toes pointing straight ahead;
2. Weight on outer edges of feet;
3. Toes gripping the ground to cup the arches;
4. Keep conscious of "heel," "outside of foot," and "big toe and spring."

General:

1. When standing, practice gripping ground with toes;
2. When walking, do the same;
3. When sitting, cross feet and practice cupping arches.

Exercises and Postural Aids: Twice daily, barefoot as soon as possible, and toes always straight ahead. Time—six minutes.

1. Wall maneuver: begin at wall, walk around room five times, checking posture at wall each time.
2. Chair maneuver: depress and elevate the big toe twenty times (each foot).
3. Neck rotation with muscles on stretch; five times.
4. Arms extended forward and backward with deep breathing, ten times.
5. Touch floor with knees straight; five times.
6. Leg raising, lying on back; five times.

7. Push back into floor and relax alternately; ten times.

8. Up on toes, cupping arches by throwing weight on smaller toes; ten times.

9. Up on toes; roll out on sides; and down; ten times.

10. Feet together; roll out on ankles; ten times.

11. Walk across room on toes, and back on outer sides of feet; three times.

12. Manipulate feet as directed; five times.

PROPER SHOES

The primary purpose of the shoe should be protection of the foot. Unfortunately, however, civilized man has turned this protective covering into a decoration and a support. The average shoe marketed today is designed to serve three purposes, (1) protection against the elements and the hard surfaces of floors, sidewalks and streets, (2) adornment in accord with the rapidly changing styles of sales promotion managers, and (3) support for a weakened organ that through improper use is unable to perform efficiently its primary functions of weight bearing and locomotion.

The foot, if properly used, could quite efficiently and comfortably carry on over the hard surfaces marking the pathways of civilization without the shock absorbing rubber heels and without the heavy soles and shanks that characterize present day footwear. From the standpoint of pedal efficiency, even in civilized environment, the light weight leather mocassin of the Indian is not surpassed by the cumbersome leather shoe. The Indian molded his mocassin to the shape of his foot; civilized man molds his foot to the shape of his shoe.

It is useless in this day, however, to long for the mocassin of the past, since society could hardly be expected to adjust itself to the business man wearing mocassins in his office or to the lady wearing them for the theatre. Even in the face of this the situation is not as sad as might be expected for there are many shoes on the market today that serve their protective and even their decorative functions at a minimum of interference with weight bearing or locomotion. Properly designed shoes can be had in practically any store that carries even a fair range of shoe stock. These shoes, however, usually are not on display and they must be requested specifically. Nor is the store manager to be blamed for this when the buyer is attracted to the store that most effectively displays shoes conforming to the standards set by nationally advertising fashion designers.

The fact that properly designed shoes do not always measure up to our changing conceptions of attractiveness must be taken into consideration. Little difficulty is experienced with male patients, since comfort usually commands deeper respect in the male foot sufferer's mind than does style. Such is not the case with women. A woman could hardly wear a corrective shoe to a tea or a ball, but, fortunately, such slavery to foot health is not necessary. Women will almost always submit to the corrective shoe if they are told that it must be worn only during the major portion of the day. The corrective shoe has its place in housework, shopping and walking, and if it is worn during these times, the most preposterous of style shoes, so long as it is not frightfully small, can do no harm during an evening's wear.

The inner border of the shoe along the first metatarsal should be straight and it should parallel a line perpendicular to the heel base. The misleading lines marked on the soles of shoes by manufacturers should be disregarded since their purpose is illustration for high pressure sales talk rather than measurement for proper shoe design. The front of the shoe should have a wide outward and backward sweep from the tip of the first toe around and behind the fifth toe. The blunt toe does not necessarily mark a properly designed shoe and it often leads one into buying a shoe that is too narrow. Many good shoes, however, are made with blunt toes for the reason that shoeman have difficulty in convincing the customer that a corrective shoe can have

a slanting toe. The blunt toe is easier to sell to the person hunting a comfortable shoe.

The "combination last" is perhaps best for the average foot and this is particularly true in women. In the "combination last" shoe, the ball is one or more sizes wider than the heel. There should be room enough in the ball and cap of the shoe to allow the toes to separate and straighten and to flex when standing and walking. At the same time, the counter should grasp the heel snugly and the vamp should pull up firmly over the instep.

In older people a rigid shank is advisable. In children and young adults the shank should be flexible.

The sole should be flat and fairly flexible. The usual type of heavy rocker sole makes perfect foot function an impossibility because the bulge downward of the sole is just beneath the upward elevation of the central metatarsal necks. It is necessary also for the sole to project beyond the border of the foot in weight bearing because if it does not, the dorsum of the foot is compressed by the vamp and the toe cap.

The heel of a shoe makes walking easier by inclining the body somewhat forward. The reason for this is that the calf muscles cannot raise the body on the toes when the knees are extended, unless the center of gravity is first shifted forward. The heel must be broad. Its height may vary from three-quarters of an inch in men's shoes to one inch or one and one-quarter inches in women's shoes. The increased elevation of the Cuban heel is deceptive because the foot is lifted at a point farther forward. This heel was designed as one that would appear to be a low heel and at the same time appreciably elevate the back of the foot.

The size of the shoe must be correct. If, under weight bearing, the vamp and the toe cap are stretched tightly over the dorsum of the foot, the shoe is too narrow, and the reason for this is obvious. When the sole is too narrow, the foot, when under pressure, bulges over the sides of the sole and pulls down on the vamp. The best and simplest test for length is the relation of the first metatarsal head to the flare of the sole. The metatarsal head must push downward at the inner flare of the sole. While checking on a patient's shoe size, it is wise to make certain that the hose afford the feet adequate room.

It is always advisable to have the patient buy the shoes on approval so that they may be brought to the physician's office for inspection. Too often the salesman will sell a patient the wrong size or the wrong shoe because he does not have the particular shoe and size in stock at the time. In addition, the various appliances and supports put in the shoe by the manufacturer for sales purposes can be removed at this time.

Since special shoe adjustments are rarely necessary in the treatment of the uncomplicated weak foot, discussion of this subject is omitted.

THE ARCH SUPPORT

The arch support is the factor of least importance in the treatment of the uncomplicated weak foot; in the complicated weak foot it plays a very important role. The support mechanically shifts the foot into its proper posture and it holds the foot in the corrected position until proper exercises have elevated the threshold of fatigue in the plantarflexors and in the supinators.

Great caution must be exercised with the support. It is a temporary measure and it should be used only after the patient fully appreciates that the arch support will not only not cure his condition but that it is the factor of least importance in the treatment. Its value in aiding easily exhausted muscles and in giving the patient the feel of correct foot posture is overshadowed and invalidated when the patient thinks the support is the cure.

Intelligent and cooperative patients whose work does not require prolonged standing, and whose muscles are not too easily fatigued, progress more rapidly without the support. When the support is not

used, the chair maneuver assumes still greater importance. The support must be used in those patients in whom the threshold of muscular fatigue is low enough to lead to daily discomfort, in those whose work requires standing for considerable periods of time, and in those who do not readily comprehend the chair and wall maneuvers.

When used, the support is worn continuously for from four to six weeks. At the end of this time its use should be tapered down over a period of two to four weeks so that within six to ten weeks from the time of beginning treatment, the patient should have discarded the support.

If the support is to assume, in part, the hammock function of the supinator muscles and the calcaneoscaphoid ligament and if it is to hold the foot in the corrected position, its shape must conform to that of the pedal arch system and its size must conform to that of the individual patient. Few of the supports used meet either of these requirements.

The foot is a system of arches comprising an architectural unit (Fig. 7) and if the load carried by the unit is improperly distributed at any point, the entire system is subject to improper stresses. The so-called inner and outer longitudinal arches, the anterior and the transverse arches are merely imaginary lines representing major stress areas in an architectural system. For this reason, the practice of supporting one of these imaginary arches, or stress areas, in the hope of correcting the improper subjection to stress throughout the entire foot, is obviously illogical. If one area is subjected to improper stress, load distribution in the entire system must be abnormal.

The practice of using factory made supports, or standard, ready-made forms, is likewise a mistake. The variations in the size and shape of the pedal arch system cannot be met by ready-made supports. Feet may be long and narrow or they may be short and broad; the dome of the arch system may be high or low or it may be acute or obtuse; the toes may be long, or they may be short and thick. The support must be made to fit the individual foot.

The shape of the elevated supporting surface should simulate that of the model shown in Figure 7, if it is to support the entire unit. The elevation begins just behind the head of the first metatarsal (Figs. 5 and 17) and runs outward and forward in a curve around the head of this bone to gain the undersurfaces of the necks of the second, third and fourth metatarsals. It then makes a long sweep backward running medial to the fifth metatarsal head but slipping gradually, in its backward sweep, beneath the medial half of the fifth metatarsal body and the cuboid bone. Just posterior to the calcaneocuboid articulation it makes a fairly sharp medial turn to end at the medial side of the foot in front of the tuberosity of the calcaneus.

Clinically, the guiding points in mapping a support for the foot are the first metatarsal head, the necks of the second, third and fourth metatarsals, the fifth metatarsal head, the calcaneocuboid articulation and the anterior and medial border of the tuberosity of the calcaneus. The patient stands on a piece of paper, with his foot pointing straight ahead, and a line is drawn around the foot (Fig. 17). Marks are then made just posterior to the heads of the first and fifth metatarsals, A and B, at the calcaneocuboid articulation, C, and just anterior to the tuberosity of the calcaneus, D. The patient then sits down while keeping his foot in place on the paper. The front of the foot is lifted so that the site of the third metatarsal neck may be determined by palpation. A mark is placed at this point, E. These marks are then connected by a line.

In making the support, a piece of heavy paper is cut to fit the insole of the shoe (Fig. 18). The tracing of the foot, on which the figure of the elevated area has been drawn, is then transposed to the paper representing the shoe insole. Two pieces of thin leather, triple split pigskin or calfskin, are next cut from the insole pattern. The leather piece that will be the top is marked from the insole pattern and a small flap is

allowed to protrude from the inner edge of what will be the supporting surface (Fig. 19). The two leather pieces are now sewn together around the edges and along the line marking the elevating surface so that a pocket, representing the supporting surface, opens on the inner side beneath the flap.

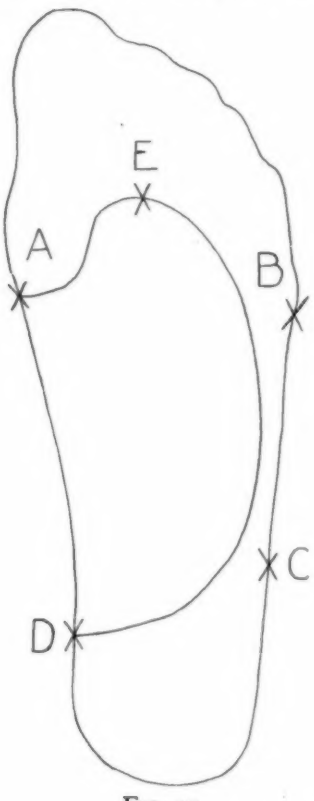

Fig. 17.

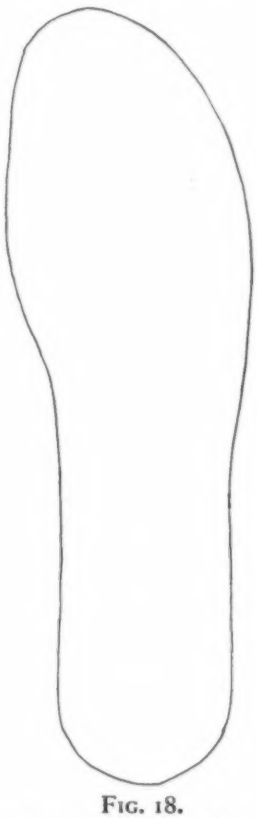

Fig. 18.

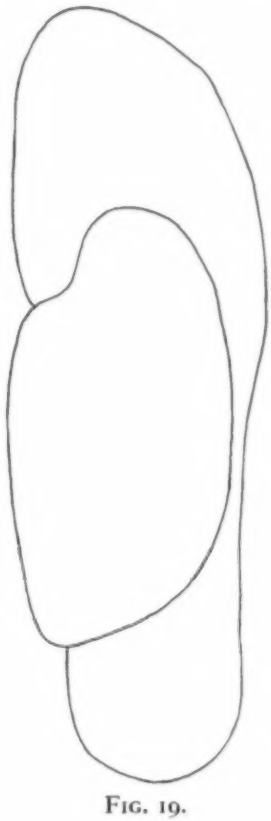

Fig. 19.

Fig. 17. The tracing of the patient's foot.
Fig. 18. The tracing of the shoe insole.
Fig. 19. The tracing of the upper surface of the support.

A piece of harness felt is cut to the shape of the supporting surface, its edges are beveled to the shape of the foot, and it is slipped into the leather pocket. The height of the harness felt and its degree of elevation vary with the individual foot.

There are, of course, many variations from this support but this is the one that is usually indicated. Such a support conforms in shape to the patient's arch system, it fits the shoe, and fits the foot. It is easily made in a short time with the help of a competent shoemaker.

SUMMARY

The author has attempted a presentation of the rationale in the attack on the distortion of physiology leading to the common type of weak foot, that associated with poor body posture. The discussion has been limited to the uncomplicated weak foot, valgus relation, this abnormality being taken as the starting point in a large number of the pathological conditions of the foot, such as flat foot, callous, arthritis with true or false ankylosis, etc., that result from maladaptation of the weight bearing mechanism to the superstructure.

Briefly, the sequence of events appears to be as follows: slouch posture with a forward shift of the line of gravity of the body, lumbar lordosis, increased pelvic tilt, internal femoral rotation, internal astragalar rotation, valgus relation. The effect of val-

gus relation on the efficiency of the foot is discussed.

It is pointed out that there are five therapeutic factors concerned in readapting the weight bearing mechanism to the superstructure and that all of these factors—postural correction, correct usage of the feet, exercises, proper shoes and arch supports—must be employed simultaneously.

Absolute cooperation of the patient is essential since the plan of treatment has as its goal the development in the individual of a consciousness of posture that is followed eventually by a posture reflex. This necessitates first of all the instruction of the patient in the elements of correct posture. The "wall and chair maneuvers" are described in this connection.

Development of neglected muscles through exercises enables the patient to pull himself into correct posture and to stay there. This act in time becomes reflex. An exercise routine is given and explained.

It is obvious that the foot cannot function efficiently when the shoe covering it is not properly constructed and correctly sized. The elements of a good shoe are discussed.

The arch support is considered from the mechanical and clinical points of view.

Patients for postural correction must be selected with care since readjustment of a posture that has been maintained for years is a serious matter. In patients over fifty years of age the weak foot is almost invariably accompanied by various pathological sequels. Palliative treatment of these complications should be undertaken immediately and followed while postural correction is in progress. This latter correction must be slow and extended over a period of many months or even several years.

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CHRONIC HYPERTHYROIDISM

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HYPERTHYROIDISM is a state or condition in which the individual patient is affected by an excess of thyroid secretion or thyroxin as the result of an overactive thyroid gland. Hypothyroidism is the opposite condition as the result of a decrease in thyroxin.

The recognized test for hyperthyroidism and hypothyroidism is the basal metabolic rate, and the rule usually accepted as a standard is "if hyperthyroidism is present the basal metabolic rate is above normal, and if the basal metabolic rate is normal then no hyperthyroidism exists." In most instances one can depend upon this rule, but there are exceptions. One must not accept either a single high or a normal basal metabolic rate as proof of the presence or absence of thyroid toxicity when it does not agree with the clinical findings.

The terms acute and chronic have not been used previously in thyroid literature. We occasionally see patients in which the acute hyperthyroid state has developed suddenly following a severe fright or an accident. One patient seen sometime ago, developed a diffuse toxic goiter with exophthalmos within forty-eight hours after an automobile accident in which she sustained a severe injury and one of her children was killed. She immediately manifested all the symptoms of acute thyrotoxicosis with an enlarged and pulsating thyroid gland and marked exophthalmos. Another patient realizing upon awaking in the morning that her room had been burglarized during the night, gave immediate evidence of all the symptoms of an acute hyperthyroidism. During the World War, there were a number of soldiers in whom diffuse toxic goiter with exophthalmos developed suddenly following their first battle. In such cases as these I think the term "acute" is applicable. For several years I have noticed goiter patients with toxic symptoms whose basal metabolic rate was normal or subnormal. Most often the goiter had been present for several years before the symptoms developed and some of these patients had been to several doctors and had been told that they had no goiter, because the basal metabolic rate was normal or subnormal, in spite of a visible enlargement of the thyroid gland and definite symptoms of thyrotoxicosis. The symptoms in these patients were insidious in their development and often it was hard to determine just when the illness really began. They complained of nervousness, palpitation of the heart, insomnia, choking sensation, increased sweating and at times loss in weight. An individual patient may have one or more of these symptoms.

As diagnosticians, we have become increasingly dependent upon laboratory tests and at times are inclined to overlook the clinical picture that makes the diagnosis evident. I do not wish to underestimate the value of the laboratory as I think it should be used to the fullest, but in thyroid disease when the laboratory test does not agree with the clinical picture, I think we should ignore the metabolism test.

To this group of patients with unmistakable signs and symptoms of thyroid toxemia and who have a persistent low basal metabolic rate I have applied the classification "chronic hyperthyroidism." I have collected from my records a group of 60 cases consisting of both diffuse and nodular goiters in which every patient had

definite symptoms of thyroid toxemia and in no instance was the basal metabolic rate above normal, in this series it varied from minus 37 to plus 12, with an average of plus 2.5 per cent.

Clute in 1928, called attention to a small group of borderline cases of hyperthyroidism with normal or subnormal basal metabolic rates. Troell in 1932, reported 14 similar cases, and Plummer in 1931, reported a case of hyperthyroidism with a basal metabolic rate of minus 9 per cent. In 1934, Gordon and Graham reported a series of both diffuse and nodular toxic goiters in which the basal metabolic rate was consistently low. None of these writers have used the term chronic hyperthyroidism which I think so aptly describes this condition.

All of the patients in my series had a subtotal thyroidectomy followed by relief of symptoms in the majority of instances. There were 3 men and 57 women in the group. The average age was 32.8 years, the duration of the goiter was 7.3 years, duration of symptoms was 1.1 years. The pulse rate was often normal, but averaged 88; the myocardium in some cases had become permanently damaged.

Just why these patients should have a persistent low basal metabolic rate is not entirely clear. There are persons who normally have a lower rate and, therefore, a rate that would be considered normal to one individual might indicate thyrotoxicosis in another. Theoretically, it might be suggested that certain individuals with chronic hyperthyroidism have "a low threshold point," as internists say of the diabetic, and there is a constant spilling over of toxic products day after day and year after year with no appreciable rise in the basal metabolic rate, and finally the patient becomes aware of certain symptoms which increase in severity until he consults the doctor. It is possible that the very chronicity of the condition in itself is responsible for the low basal metabolic rate in that the patient gradually establishes a tolerance to the thyroid toxemia.

One should be very cautious in diagnosing hyperthyroidism in a patient who has a normal basal metabolic rate and look for positive signs of hyperthyroidism in confirming the diagnosis, remembering that there are other conditions which may be confusing, such as neurasthenia or neurocirculatory asthenia.

Many times I have observed complete relief following operation upon these patients in which the results differed in no way from that of patients with similar symptoms and an increased basal rate. This seems to establish definitely that too much emphasis may have been placed on the basal metabolic rate in the interpretation of clinical data in thyroid disease.

The end results in my series of 60 cases following operation, were as follows: 93.4 per cent were relieved of their symptoms and 6.6 per cent were improved. One nodular goiter recurred eight years after operation. There were no deaths in the series. I have not included in this group any patients who had received iodine as a therapeutic measure up to the time they were received for treatment.

We have here, then, a symptom complex of goiter with positive manifestation of thyroid toxemia, and yet the basal metabolic rate was not above normal in a single patient.

The study of this series of patients shows that clinical hyperthyroidism often occurs in the presence of a persistent low basal metabolic rate. We should be very careful about accepting laboratory reports at face value when they do not agree with our clinical diagnosis. The majority of these patients were restored to normalcy by subtotal thyroidectomy. This operation in the hands of a surgeon experienced in thyroid surgery offers a cure to these patients with practically no risk to life and without danger of their condition being made worse.

CONCLUSIONS

1. There evidently exists a chronic hyperthyroid state in which the symptoms

develop insidiously, and in which usually the basal metabolic reading remains low, and these cases as a rule are relieved by subtotal thyroidectomy.

2. The terms acute and chronic, although not formerly applied to thyroid toxemias, appear to be applicable to the patients reported in this series.

3. The interpretation of clinical data should not be based on any one laboratory test.

4. The basal metabolic rate while very helpful when it is elevated should be ignored when normal or subnormal, in the presence of unmistakable evidence of hyperthyroidism.

5. An important fact to bear in mind in connection with the thyroid heart, is that it is one type of heart disease which is preventable, provided the thyrotoxicosis is recognized early and subtotal thyroidectomy is performed before the heart becomes permanently damaged.

6. Because of the great frequency of cardiac disease in patients with adenoma of the thyroid, particularly in patients of middle age or beyond, removal of all adenomas before cardiac symptoms develop, is indicated as an important means of prevention of heart disease.

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SIMPLE MASTECTOMY IN CANCER OF BREAST

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I FEEL that the cure of cancer of the breast is theoretically best served by radical mastectomy; however, when we evaluate the end results, we are immediately compelled to stop and debate whether this theory of radical mastectomy is logical in view of our present results and knowledge concerning cancer. In carcinoma of the breast, we are fundamentally dealing with a group of tumors, the majority of which naturally have a great tendency to metastasize, and in many cases this cellular spread might have gone to distant organs without any demonstrable evidence either clinically or roentgenologically. Some years ago, I studied microscopically the cellular structure of cases having a radical mastectomy and became convinced that the all important factor in the disease was the cellular structure and not radical surgery. I am now evaluating the end results of simple mastectomy and irradiation after a five year period.

To justify the operation of simple mastectomy in cancer of the breast, as opposed to radical mastectomy, there are two approaches that demand exploration; (1) the technical aspect of the operation, and, (2) the infinitely more important biologic aspect of the problem as it directly affects breast cancer. It would be unnecessary to discuss at length, in a surgical publication, the technical problem of simple mastectomy. Briefly, in this series a simple mastectomy was done by using the cautery, making an elliptical incision on either side of the breast, carrying it down to the surface of the pectoralis major muscle. The breast was removed and this muscle was seared with the cautery; glands that were large and easily accessible were removed. No attempt was made to remove the entire axillary contents or the muscle. This, as can readily be seen, represents the essence of simplicity for this surgical procedure. But the second or biological phase presents a more complex problem.

In the middle of the last century, the cellular theory in biology was evolved by Schleiden and Schwann, and almost immediately its influence was seen in medicine. The direct outcome of this was the founding of modern pathology in which Virchow played so brilliant a part. In dealing with cancer on a cellular basis, the belief was rightfully accepted that cancer started in one locality and, from this primary lesion, spread and metastasized to other parts of the body. The cure of this disease, following the other premise, was dependent upon the thorough and radical removal all tissue adjacent to the cancer. Radical surgery developed from this premise and the technical problems involved in attempting the cure of this disease were brilliantly carried on by Valpeau, Moore, Halstead and Willy Meyer, all fervent advocates of radical surgery.

The knowledge available up to very recent times justified, I believe, such a surgical concept. However, in 1902, Von Hansemann, in his writing on surgical pathology, described the very elemental fact that the type of cells which make up the cancer will exhibit a very definite tendency either to revert back to a more embryonal type cell or progress forward striving to approach the more normal adult cell. Within the confines of this biological fact lies the major portion of the cancer problem; also of tremendous importance is the bed of tissue in which the cancer grows and the cellular reaction in the cancer bed. In cancer, we find varying degrees of these biological facts, and an evaluation of the behavior of the cancer may be deter-

mined by the type of cell dominating the tumor and the cellular make-up of the cancer bed. These principles, although

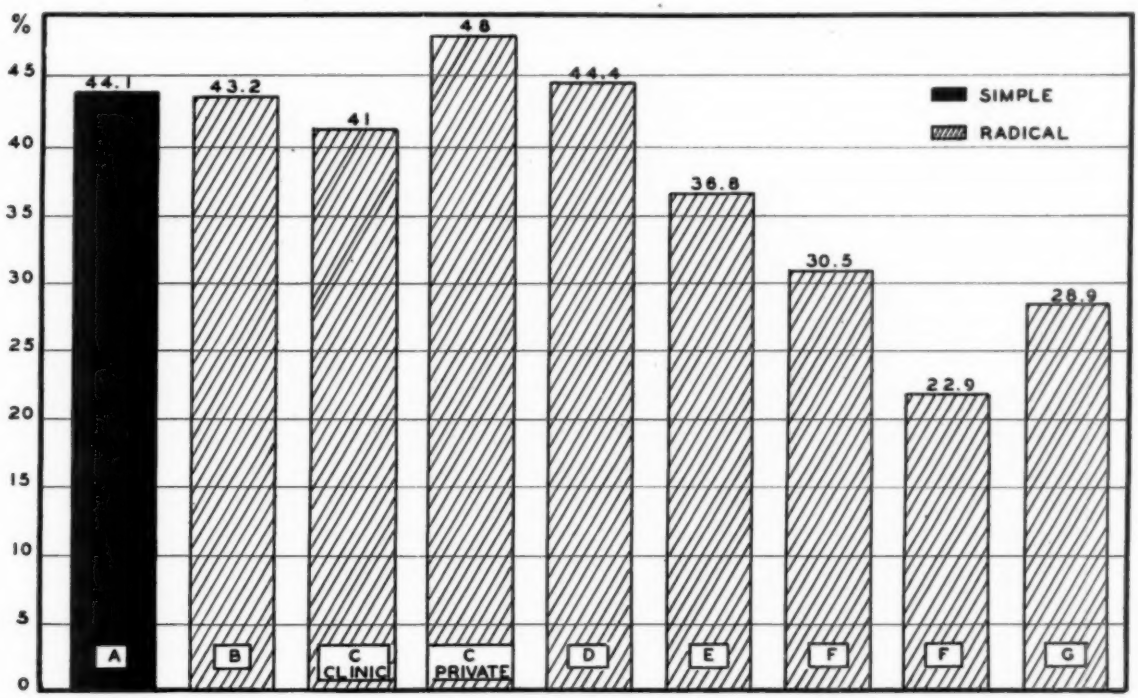

Fig. 1. Comparative results at the end of five years in simple and radical mastectomy.

known since the beginning of the century, were not used clinically until 1923 when Broders, studying cancer of the lip, showed of what tremendous value they were to the surgeon and the clinician in determining the prognosis and treatment in cancer.

Although this paper deals only with cancer of the breast, an intelligent understanding of this fundamentally sound biological and pathological principle of grading cancer equips us with the most valuable agent at present available to interpret all cancers clinically.

Theoretically, we all agree that cancer starts at one area of an organ and, if we remove this early and radically, we give the patient every good chance of cure. This premise is undeniable and all students of the problem are unanimous in agreement. However, the lamentable fact is that the very early stage of the most active cancers are probably present without the patient's knowledge, and with all our present diagnostic equipment are undetectable and represent an absolute subclinical picture which we have at present no known method of recognizing. The so-called early case, clinically, is very often a late case pathologically and the cells might have gone to distant metastatic areas probably before the patient is even aware of the primary tumor. The extent of metastases is directly dependant upon first, the grade of the cancer, and secondly, upon the cellular defense exhibited in the cancer bed where the tumor grows. The palpable mass in many breast tumors, when it becomes recognizable clinically, is not always the entire cancer itself but the bulk of tissue heaped about the cancer in the so-called cancer bed as a cellular defense mechanism.

These principles will often be the deciding factor in determining the ultimate fate of the patient. The futile role of radical surgery becomes more apparent when we realize that cancers of the breast are predominatingly high grade active tumors. To date, there is no evidence that radical surgery is beneficial or curative in dealing with tumors whose natural history shows tendency to metastasize rapidly. This observa-

tion is of paramount importance when we realize that most tumors of the breast are high grade and fundamentally a metastasizing group.

The intelligent consideration of these biological facts in dealing with this problem is, in my opinion, more important than any technical procedure at present available in any form of radical surgery.

An evaluation of the results of radical surgery, when studied comparatively with a corresponding group of cases with simple mastectomy and radiation, leaves one convinced that the role of surgical radicalism is far removed from surgical idealism.

The graph represents a series of 40 simple mastectomies, with irradiation, after a five year follow-up compared with other larger series of radical mastectomies.

In the series under discussion, 80 cases were originally subject to analysis but only 40 could be followed. Mindful of the limited material, I have compared the mortality in this series, A, (simple mastectomy), with the various other series reported after a five year follow-up: B, C-Clinic, C-Private, D, E, F, F′, and G. These latter groups represent a total of 1276 radical mastectomies. One is very forcefully impressed with the marked similarity in the end results, whether radical or simple mastectomy is done. The first part of series C represents dispensary patients, while the second part represents private patients treated in the same hospital. When both are averaged, the figures closely coincide with series A.

SUMMARY

1. A series of 40 simple mastectomies with irradiation are reported and compared with a larger series of radical mastectomies and irradiation, (series C-clinic and C-private receiving the maximum *x*-ray therapy available at present). The five year end results are very similar.

2. The cellular structure of the tumor is the dominant factor, and surgical technique, irrespective of the extent of its radicalism, plays a definitely secondary role.

DIFFERENTIAL DIAGNOSIS OF BENIGN AND MALIGNANT SMALL LESIONS OF STOMACH

AN ATTEMPT TO EVALUATE STATISTICALLY THE VARIOUS SYMPTOMS AND LABORATORY FINDINGS

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IT is usually accepted without question that the age of the patient, the type of history, a change in symptoms, the gross, microscopic and chemical examination of the gastric contents and roentgenologic examination of the lesion are of value in deciding whether a gastric lesion is benign or malignant. Yet we have often found that many of the symptoms and laboratory findings in cases of carcinoma were the same as those in cases of ulcer, and we have so often been at a loss to know exactly how much emphasis to place on any one finding or combination of findings that we have decided to attempt to evaluate statistically just what the actual importance of some particular finding is, so that it can be used more intelligently than at present in the differential diagnosis and in the selection of patients for medical or surgical treatment.

METHODS AND MATERIAL

We chose 4.4 cm. as the upper limit for the diameter of lesions to be studied. After placing this limitation on the size of the lesion we could still be reasonably sure that practically all benign ulcers would be included in our series, inasmuch as Alvarez and MacCarty found that 638 benign ulcers treated surgically at The Mayo Clinic from 1920 to 1927, inclusive, were smaller than 4 cm. in diameter. A diameter slightly more than 4 cm. was therefore selected as the upper limit of size, realizing that it was impossible for the roentgenologist to judge accurately the size of lesions and that benign lesions larger than those in Alvarez and MacCarty's series might possibly occur. In selecting the material in this way, practically all benign gastric ulcers and cancers of a size about which confusion regarding benignity or malignancy might arise are included in our series. There would be no value in comparing data on small benign lesions with data on cancers of all sizes.

We chose for study the 135 small gastric cancers and the 513 benign gastric ulcers, unassociated with duodenal ulcer, that were treated surgically at the clinic in the years 1926 to 1930, inclusive. It is to be noted that the ratio of these small gastric cancers to benign ulcers is 1:3.8. One hundred and thirty-five cases of combined benign gastric and duodenal ulcers were excluded from the series, since it was felt that a more accurate comparison of the clinical and laboratory findings of benign and malignant small lesions of the stomach could be made if those gastric ulcers associated with duodenal ulcer were excluded.

For detailed study we selected the records of the first 100 patients with benign gastric ulcer and the first 100 with gastric cancer, the diameter of whose lesion the pathologist measured and found not to exceed 4.4 cm. In estimating the relative figures for the two groups for the five year period, the figures obtained in the study of the 100 benign gastric ulcers were multiplied by 5.13 (513 benign ulcers having been observed in the five year period), and those in the study of the 100 gastric cancers by 1.35 (135 cancers less than 4.4 cm. in diameter having been observed in the five year period).

It is realized that data obtained in this manner are not absolutely accurate in at

least two respects: In the first place a greater degree of accuracy would be obtained by detailed examination of the records of all the cases for the five year period, and in the second place the numbers of cases of benign gastric ulcer and small cancer used for the five year period do not represent the actual incidence of the two diseases. Cancers are probably more numerous than these figures would indicate, for a small percentage of them, even of this size, are for various reasons not resectable. Ulcers are likewise more numerous than is indicated, because some benign ulcers were treated medically during this period. While the figures obtained are therefore only relative, we believe that such figures are accurate enough for all practical purposes, that they do give a fairly accurate idea of the relative frequency of the various findings and that they may be used to assess the diagnostic value of such data.

ODDS BASED ON RELATIVE INCIDENCE OF THE TWO TYPES OF LESION

The odds that a lesion is benign or malignant, based on the relative incidence of the two types of lesion, have just been demonstrated when we stated that 135 cancers and 513 ulcers, within the size limits chosen, and assuming that the number of cancers which were not resectable was approximately equal to the number of ulcers treated medically, were treated surgically at the clinic from 1925 to 1930, inclusive. On the basis of incidence alone then, a lesion of such size has approximately four chances out of a five of being benign before any other data are accumulated.

ODDS BASED ON SEX

For this five year period, the ratio of benign gastric ulcers to small gastric cancers among males was 4.37:1, and among females 2.25:1 (Table 1). In other words, with lesions of this size, benign gastric ulcer occurs more frequently than gastric cancer in both sexes. If the patient is a man, however, the chances that one is dealing with a benign ulcer is greater than if the patient is a woman.

ODDS BASED ON AGE

The average age of patients with small cancers was 52.9 years, and of those with ulcers 48.5 years. This average age was so similar that the diagnostic significance of age seemed negligible. That this is not actually the case is seen when the number of patients with cancer is compared according to each of the several decades of life with the number of those who had benign ulcers (Table 1). Benign gastric ulcer was found to be twenty times more prevalent in the third decade of life than was cancer of the size chosen. The relative incidence of benign gastric ulcer was greater than that of gastric cancer of the size chosen in all decades but the eighth, and it in general diminished as the age of the patient increased. Thus we see that while it is generally true that the older the patient the greater the likelihood of the gastric lesion being malignant, it is only when the eighth decade of life is reached that the odds actually favor the lesion being malignant.

Table 1

Relative Chances of a Small Gastric Lesion Being Benign, Based on Sex or Age

Sex and Age	Number of Cases (Estimated)		Relative Chances That Lesion Sampled from Group Will Be Benign
	Small Gastric Cancer	Benign Gastric Ulcer	
Males	103	441	4.3:1.0
Females	32	72	2.2:1.0
Age, years.			
20 to 29	1	20	20.0:1.0
30 to 39	18	67	3.7:1.0
40 to 49	33	205	6.2:1.0
50 to 59	42	154	3.7:1.0
60 to 69	30	62	2.0:1.0
70 to 79	11	5	1.0:2.4
Average	52.9	48.5	

ODDS BASED ON SYMPTOMS

Duration of Symptoms. Irrespective of the duration of symptoms, whether they be brief or long, a gastric lesion of the size chosen always has a greater chance of being benign, and as the duration of symptoms increases, its chance of being benign also increases. In other words, the longer the history the greater is the chance that the lesion is benign. Thus it was found that the odds in favor of benignancy are about seven times greater when symptoms have been present from ten to twenty-five years than when they have been present one year or less.

Type of History. Before proceeding, a word of explanation is needed for some of the terms that are to be used. Cases were divided into three groups according to the type of history found. The first group contained cases with an ulcer type of history; in this group the symptoms and history suggested peptic ulcer, and there had been recurring attacks of hunger pain for a number of years. In the second group the histories were not so clear cut, although certain features suggested the presence of peptic ulcer. The patients in this group all complained of an ulcer type of distress, with at least partial relief on taking food and alkali; the symptoms were continuous and lacked the periodicity which one expects in a typical ulcer history. There were also other details which threw doubt on the diagnosis of ulcer. The histories of this group will be referred to as being of the "irregular ulcer type." In the third group the history did not suggest the presence of ulcer, there being either no history of indigestion, or else only a very short one without the characteristics of ulcer.

The incidence of the ulcer-like, the irregular ulcer type, and the non-ulcer type of histories in the five year period was respectively 5.6, 3.7, and 1.3 times as great in cases of ulcer as in those of cancer (Table II). In other words the type of history itself does not at any time indicate a relatively greater chance of the presence of a small cancer; however, the ulcer type of history does favor the presence of benign gastric ulcer more than the irregular ulcer type of history, and the irregular ulcer type of history favors a benign gastric ulcer more than the non-ulcer type of history does.

Change in Symptoms. In reviewing the histories, instances of the ulcer-type of complaint were found in which, later, the complaint lost its characteristic periodicity and its usual relationship to meals; this is hereinafter referred to as "a change in symptoms." Such a change occurred three times as frequently in cases of ulcer as in those of cancer, and, contrary to the accepted interpretation, it is not evidence favoring malignancy. It is to be remembered that symptoms are changed in this fashion by the onset of complications such as obstruction, penetration, and perigastric involvement, hour-glass deformity, and even by an increase in size, as well as by the cancerous transformation of an ulcer in the absence of ordinary complications. A change in symptoms may possibly be

TABLE II

RELATIVE CHANCES OF A SMALL GASTRIC LESION BEING BENIGN, BASED ON DURATION OF SYMPTOMS, TYPE OF HISTORY, AND CHANGE IN SYMPTOMS

Duration of Symptoms, Years	Number of Cases (Estimated)		Relative Chances that Lesion Sampled from Group Will Be Benign
	Small Gastric Cancer	Benign Gastric Ulcer	
½ or less	42	82	2.0:1.0
½ to 1	26	31	1.2:1.0
1 to 2	20	46	2.3:1.0
2 to 5	20	114	5.7:1.0
5 to 10	15	97	6.5:1.0
10 to 25	12	122	10.2:1.0
25	0	21	21.0:0
Type of history.			
Ulcer	69	384	5.6:1.0
Irregular	18	67	3.7:1.0
Non-ulcer	48	62	1.3:1.0
Change in symptoms	27	87	3.2:1.0

used as evidence of the presence of cancer when such complications are absent.

ODDS BASED ON GASTRIC ANALYSIS

The test meal consisted of eight arrowroot crackers and 400 c.c. of water; this was taken in the morning when the patient was fasting. A sample of gastric content was aspirated through a Sawyer tube at the end of an hour. If free acid was present, or if there were signs of retention, the stomach was evacuated as completely as possible and another sample from the mixed sample was titrated. If no free acid was present, and there were no signs of retention, additional specimens were taken at intervals of fifteen minutes for an hour. If the gastric contents did not contain free acid after the two hour test, it was assumed that achlorhydria was present. Obviously if stronger stimulants such as histamine had been used, free acid would have appeared in the gastric contents of many other patients.

Gastric Acidity. Those who find the following figures (from Table III) contrary to their previous conceptions must remember that the gastric acidity of patients with small gastric cancers, and not cancers of all sizes, is being compared with that of patients with benign gastric ulcers.

When achlorhydria is present the odds favoring cancer are 2:1. When free acid in concentrations of less than 20 clinical units is present, the chances in favor of gastric ulcer being present are about equal to those favoring small cancer. As the values for free acid increase to between 20 and 40, 40 and 60, and 60 and 80 clinical units, the odds are, respectively, 5:1, 14:1 and 46:1 in favor of benign gastric ulcer (Table III). When the acidity is greater than 80, the odds in favor of benignancy are probably even greater. In other words, achlorhydria and free acidity less than 20 clinical units do not preponderantly favor the diagnosis of either gastric ulcer or cancer of small size, whereas free acidity greater than 20 units favors a diagnosis of gastric ulcer more and more the higher the concentration of free acid becomes. As will be seen, a concentration of free acid greater than 60 clinical units appears to be better evidence of benignancy than any other clinical or laboratory findings.

If the number of cases had been great enough to study the gastric acidity of men of different ages and then of women of different ages, the odds based on any degree of acidity would vary both with the sex and age, for we know that gastric acidity varies with sex and age in cases of both cancer and ulcer. It would be interesting to do this and find out if anything of practical value could be obtained.

TABLE III

RELATIVE CHANCES OF A SMALL GASTRIC LESION BEING BENIGN, BASED ON GASTRIC ANALYSIS

Concentration of Free Hydrochloric Acid, in Clinical Units, Following a Test Meal	Number of Cases (Estimated)		Relative Chances that Lesion Sampled from Group Will Be Benign
	Small Gastric Cancer	Benign Gastric Ulcer	
0	38	21	1.0:1.9
1 to 19	38	51	1.3:1.0
20 to 39	46	226	4.7:1.0
40 to 59	12	164	13.7:1.0
60 to 79	1	46	46.0:1.0
80 to 99	0	5	5.0:0.0
Retention	17	82	4.8:1.0
Food remnants	31	31	1.0:1.0
Occult blood	34	41	1.2:1.0

Retention. When the amount of the gastric content was greater than 200 c.c., retention was said to have occurred. The number of cases of ulcer in which retention was present was almost five times as great as the number of those of cancer for the five year period (Table III). Retention occurs when prolonged spasm or organic obstruction is present, and it is more likely to be an indication that a lesion of this size occupies a low position in the stomach or that spasm is present than that either cancer or ulcer is present.

Food Remnants. The incidence of retention of food in this five year period was

approximately the same for the two types of lesion (Table III). The occurrence of retention of food remnants in the gastric contents should not be used to differentiate benignancy from malignancy.

Occult Blood. The incidence of occult blood was slightly greater for ulcer than cancer (Table III). Occult blood in the gastric contents does not favor the lesion being either ulcer or cancer. On the other hand, the persistence of occult blood in, or its disappearance from, the gastric contents and stools during medical treatment is significant. Its persistence indicates failure of healing and its disappearance indicates that healing is taking place.

ODDS BASED ON ROENTGENOLOGIC DIAGNOSIS

Roentgenologic examination proved to be one of the most valuable single adjuncts to the differential diagnosis (Table IV). Roentgenologic reports may be divided into three groups: those in which a diagnosis of cancer is made, those in which a diagnosis of benign ulcer is made, and those in which the diagnosis is equivocal, the lesion being referred to simply as "lesion," and usually being located in the pyloric region and accompanied by obstruction. During the five year period the roentgenologic diagnosis was correct in 78 per cent of cases, equivocal in 12 per cent and incorrect in only 10 per cent. When the diagnosis of cancer was made by the roentgenologist the pathologist found cancer in 70 per cent, and benign ulcer in 30 per cent of the cases. When the roentgenologic diagnosis is cancer, the odds that the pathologist will find cancer are in our experience about 3:1. While such a percentage of correctness in the diagnosis of these small lesions may be cited with considerable pride by the roentgenologist, he may boast of much better results when the diagnosis of benign ulcer is concerned. When the roentgenologist made this diagnosis the pathologist found benign gastric ulcer in 93 per cent of cases, cancer in only 7 per cent. Given a roentgenologic diagnosis of benign gastric ulcer the odds are about 19:1 that the roentgenologist is correct. The roentgenologist's uncertainty as to the character of the lesion when he made a report of "lesion" was reflected by the pathologic findings in those cases. Cancer and benign gastric ulcer were found by the pathologist in approximately the same number of cases.

TABLE IV

ROENTGENOLOGIC AND CLINICAL DIAGNOSIS OF SMALL GASTRIC CANCERS AND BENIGN GASTRIC ULCERS AT THE CLINIC IN THE YEARS 1929 TO 1933, INCLUSIVE, AND THE RELATIVE CHANCES OF LESIONS BEING BENIGN

Roentgenologic Diagnosis	Estimated Number of Small Gastric Cancers	Estimated Number of Benign Gastric Ulcers	Total Number	Correctness of Each Diagnosis, Per Cent	Relative Chances that Lesion Sampled from Group Will Be Benign
Cancer	60	21	81	70	1.0:2.9
Benign ulcer	23	446	469	93	19.0:1.0
"Lesion"	47	31	78	..	1.0:1.5
Duodenal ulcer	4	10	14		
Negative	0	5	5		
Not rayed	1	0	1		
Total	135	513	648		
Clinical diagnosis.					
Cancer	62	16	78	79	1.0:3.9
Benign ulcer	20	446	466	96	22.3:1.0
"Lesion"	50	46	96	..	1.1:1.0
Duodenal ulcer	3	5	8		
Total	135	513	648		

ODDS BASED ON SIZE OF LESION

The size of a small gastric lesion lends certain odds for and against malignancy and benignancy. Inasmuch as Alvarez and MacCarty have previously examined the relationship of size to malignancy, using a series of cases much larger than the present one and one large enough to permit smoothing of the distribution curves, we did not study this particular point using the data from our series. Alvarez and MacCarty found that there was one chance in 15 that an ulcer smaller than a dime, 1.7 cm., and one chance in 10 that an ulcer smaller than a quarter, 2.5 cm., is already cancerous; if it is larger than a

quarter but smaller than a half-dollar, 3 cm., the chances in favor of ulcer or cancer are about equal; if it is larger than a half-dollar but smaller than a silver dollar, 3.5 cm., the chances are about 3:1 that it is cancer. If it is larger than a silver dollar it is almost certainly a cancer. The truth of the dictum that any gastric ulcer larger than 2.5 cm. in diameter is probably malignant, long proved useful at the clinic in making a decision whether medical treatment or operation should be carried out, is amply confirmed by these figures.

HOW WELL DID THE CLINICIAN USE THE DATA?

The clinician assembles and evaluates these clinical, roentgenologic and laboratory data and then makes a diagnosis of cancer, benign gastric ulcer, or "lesion" (Table IV). His diagnosis was correct in 78 per cent of the cases in this series, equivocal in 15 per cent and incorrect in only 7 per cent. If a clinical diagnosis of cancer was made, that diagnosis was correct in 79 per cent, and incorrect in 21 per cent of cases. When the diagnosis of benign gastric ulcer was made, the diagnosis was correct in 96 per cent, and incorrect in only 4 per cent of cases. When the clinician admitted his inability to label a lesion benign or malignant (in 12 per cent of cases), at operation cancer and ulcer were found in approximately equal numbers. This record compares favorably with the record for diagnosis of any intra-abdominal lesion.

A comparison of the percentage of lesions called "cancer," "ulcer" and "lesion" by the roentgenologist and by the clinician shows an almost exact reduplication of figures. Perhaps it was the excellence of the roentgenologic diagnosis that enabled the clinician to score such a high percentage of correct diagnoses. Actually, the records of the 100 cases of benign gastric ulcer and of the 100 cases of gastric cancer studied in detail show that the clinician changed the roentgenologic diagnosis in only 9 instances. How well the clinician fared when he attempted to change the roentgenologic diagnosis will be apparent from the following: Of 2 cases of benign ulcer, in the first the clinician was right in changing an erroneous roentgenologic diagnosis of duodenal ulcer to gastric ulcer but he erred in suggesting that the lesion was malignant. In the second case, the clinician did right in changing an erroneous roentgenologic diagnosis of cancer to "lesion, probably malignant," and in introducing an element of doubt as to the malignancy. In neither of these cases, however, did the clinician materially improve the roentgenologic diagnosis. He did somewhat better in 7 cases of cancer; in 4 cases the clinician correctly changed the roentgenologic diagnosis to cancer from gastric ulcer (in one case), duodenal ulcer (in one case), and "lesion" (in 2 cases). In one case of cancer he improved the accuracy of the opinion regarding the nature of the lesion by changing the roentgenologic diagnosis from gastric ulcer to "lesion," and in the remaining 2 cases of cancer he impaired the accuracy of the diagnosis in changing the roentgenologic diagnosis from cancer to "lesion, probably malignant." All in all, the clinician did not do so badly; in fact, the accuracy of his diagnosis in these 9 cases was slightly higher than that of the roentgenologist.

It is interesting to see what factor led the clinician to change his diagnosis in these 9 cases. In the 6 cases in which the clinician leaned toward a diagnosis of cancer in spite of the roentgenologic diagnosis of benignancy or "lesion," in most instances the patient was more than fifty years of age and had lost markedly in weight and strength, the history was of short duration and was of the non-ulcer type, the symptoms were progressively severe, and the gastric contents were in amounts denoting moderate or marked obstruction and contained occult blood in moderate or marked amounts and free hydrochloric acid in concentrations less than 40, more often below than above 20 clinicial units. In only 2 of the 6 cases, however, was statistical evidence actually

favoring carcinoma present; in one of these cases the patient was seventy-five years old, and in the other achlorhydria was present. In none of the 6 cases, however, did the evidence point strongly to ulcer. It seemed that the combination of factors rather than any single factor influenced the clinician's judgment. Perhaps the general appearance and condition of the patient, about which it is difficult to collect statistical evidence, influenced him also. In the 3 cases in which the clinician questioned the roentgenologist's diagnosis of cancer, the age of the patient was about the same as when the clinician leaned toward a diagnosis of cancer, but the patient was in good general condition, the history was of the ulcer type and of fairly long duration, free acidity was greater than 40 units, and there was no retention or occult blood. The roentgenologist had made a diagnosis of carcinoma, but the clinician desired to introduce an element of doubt, for the clinical evidence and examination of the gastric contents following a test meal favored ulcer strongly. In this he was justified, statistically; yet in all 3 cases he expressed his respect for the opinion of the roentgenologist by saying that the lesion was "probably malignant" in spite of the fact that, clinically, nothing pointed to cancer.

It is important to note that, in this series, the clinician has not accepted the roentgenologic diagnosis without question. Perusal of the records in the remaining cases in the series shows that this was true in these as well as in the foregoing 9 cases.

SUMMARY AND COMMENT

An attempt has been made to weigh by actual figures the value of the several symptoms and laboratory findings commonly used in the differential diagnosis of benign and malignant small lesions of the stomach measuring 4.4 cm. or less in diameter. Many interesting facts were obtained: First of all it was found that the chances were 4 of 5 that the lesion was benign on the basis of incidence alone. It was also found that patients of either sex and of all ages less than seventy years had benign ulcer more frequently than cancer. Whatever the duration of symptoms, the type of history, or the concentration of free hydrochloric acid, and whether or not a change in symptoms, or retention, or occult blood in the gastric contents had occurred, the lesion was benign more frequently than it was malignant. In other words a small gastric lesion has a greater chance of being benign, provided the age of the patient is less than seventy years, regardless of the duration of symptoms, type of history, or degree of concentration of free acid present and whether or not retention of gastric contents or change of symptoms has occurred. This is especially true when the patient is less than thirty years of age (odds 20:1), when the symptoms are of the ulcer type (odds 5.6:1), when the symptoms are of ten years' duration or longer (odds 12:1), and when the concentration of free hydrochloric acid is greater than 60 clinical units (odds 51:1). A small gastric lesion is almost certainly benign when the duration of symptoms is greater than twenty-five years (odds 21:0), when 80 or more clinical units of free acid are present in the gastric contents, and when the lesion is smaller than a dime, or 1.7 cm. (odds 15:1). This becomes less true as the age of the patient increases, the duration of symptoms and degree of concentration of free hydrochloric acid decreases and when the history is of the irregular ulcer or non-ulcer type. It is interesting that the presence of occult blood in the gastric contents and a change in symptoms, findings credited with considerable importance in favoring the diagnosis of cancer rather than ulcer, actually do not favor the diagnosis of cancer and favor ulcer only very slightly if at all. Most interesting perhaps is the finding that only if the patient is more than seventy years of age, if achlorhydria is found, and if the lesion is larger than a quarter, is there positive statistical evidence in favor of malignancy, and even

then the chance of the lesion's being cancer is only 2 or 3:1.

While the clinician assiduously gathers together such data and applies them in arriving at a diagnosis, in practice he rarely attempts to locate the gastric lesion or to decide its pathologic character on such data alone. The wisdom of such a policy is supported by these statistical studies. The clinician proclaims the limitations of such data by at once seeking the roentgenologist's opinion. Fortunately for diagnostic accuracy and for the welfare of the patient, the skilled roentgenologist has attained a high degree of efficiency in the differential diagnosis of benign and malignant small gastric lesions. At the clinic, when the roentgenologist made a diagnosis of benign ulcer the chances were 19 out of 20 that the lesion would be proved benign by the pathologist. Of all the clinical findings studied, only an age less than thirty years (odds 20:1), a duration of symptoms greater than ten years (odds 12:1), free acid greater than 40 clinical units (odds 17:1), and a size smaller than a dime, or 1.7 cm., (odds 15:1) make the probabilities of benignancy anywhere near as great. When the roentgenologist made a diagnosis of cancer, the chances were 14 of 20, or the odds about 2:1, that the lesion would be proved malignant by the pathologist. Of all the clinical findings, only an age greater than seventy, (odds 2.4:1), achlorhydria (odds 2:1), and a size greater than a half-dollar, or 3 cm., and less than a dollar, or 3.5 cm., (odds 3:1) give anywhere near as great a probability of the lesion being malignant. After the clinician had correlated the clinical, laboratory and roentgenologic data, he was able to improve the accuracy of the roentgenologic diagnosis only slightly. This merely reflects the excellence of roentgenologic diagnosis in experienced hands.

Certain very clear cut impressions have been gained from this study.

1. The presence of any single clinical or laboratory finding does not justify at this time a 100 per cent diagnosis of cancer or benign ulcer when the diameter of the lesion is less than 4 cm. The finding may strongly favor one or the other diagnosis, yet there is always a chance that that diagnosis is incorrect. The roentgenologic finding of a meniscus sign complex is an exception to this statement.

2. While we did not determine statistically the importance of various combinations of findings, it is improbable that any combination lends complete certainty to the diagnosis. It is well to remember that the pathologist alone can state whether or not he is dealing with a benign or malignant process, and sometimes even he encounters difficulty. The clinician should continually school himself to remain in doubt about the nature of the lesion until it is permanently healed or until it has been resected. If this is not done, regrettable and preventable tragedies will occur. However, the clinician may accept a roentgenologic diagnosis of benign ulcer very confidently when the patient is young, when the history is of the ulcer type, when the concentration of free hydrochloric acid is high, and when the lesion is very small. He may accept a roentgenologic diagnosis of benign ulcer less confidently when the patient is advanced in years, when the history is of the irregular ulcer or non-ulcer type, when the concentration of free hydrochloric acid is low or zero, and when the lesion is larger than a quarter. A roentgenologic diagnosis of cancer must always be taken seriously, even if the clinical data do not suggest cancer.

The degree of certainty that cancer is present or absent naturally influences the choice of medical or surgical treatment for the small ulcerating gastric lesion. Surgical removal without preliminary medical treatment is usually the treatment of choice when the odds favor the presence of a cancer; that is, when the lesion is larger than a quarter, or when the patient is more than seventy years of age, or when achlorhydria is present, or when the competent roentgenologist makes a diagnosis of cancer. This is true even though it is known before operation that the lesion will be proved benign at operation in one of every 3 or 4 cases, for if cancer is found by the path-

ologist, the patient has been given a chance for cure, and if the lesion is later proved benign an excellent type of treatment for benign gastric ulcer has been followed. Rarely, the condition of the patient will contraindicate immediate operation and medical treatment may be tried for a short time before subjecting the patient to a procedure entailing an increased risk.

Medical treatment as a further diagnostic measure may be done for a period of two or three weeks when the evidence favors the presence of a benign gastric ulcer. This should of course be done only when complications such as organic obstruction, deep perforation and hour-glass deformity are absent, when the economic position of the patient permits a carefully supervised and conducted program of hospital treatment, followed by a prolonged period of ambulatory treatment, and when the advice of a competent roentgenologist is available throughout the entire period of hospital and ambulatory treatment. This may be done more enthusiastically when the patient is young, the symptoms of long duration, the history of the ulcer type, the concentration of free acid high, and when the lesion is smaller than a dime, than when the patient is old, the symptoms of short duration, the history of a non-ulcer type, the concentration of free acid low, and when the lesion is smaller than a quarter but larger than a dime. Even when all these conditions are favorable to the diagnosis of ulcer, medical treatment should be continued after a trial of two to three weeks only if the symptoms are completely relieved, the lesion shows definite decrease in size on roentgenologic examination, and occult blood disappears from the gastric contents and feces, prerequisites for continuing medical treatment laid down by Jordan, Eusterman and Balfour, and others. If these things can be accomplished within this period of time, medical treatment is continued, and if the lesion eventually heals so that it is not visible roentgenologically, it is well to remember that occasionally a cancerous lesion apparently heals, as in the cases reported by Rivers and Dry and that repeated roentgenologic and clinical examinations are necessary for months and even years after apparent healing has taken place. Fortunately, disappearance of the niche and all other roentgenologic evidence of a lesion is usually a sign that the lesion is benign, as has been pointed out by Eusterman and Balfour. If the indications for continuing medical treatment are not present at the end of two to three weeks, surgical intervention should be undertaken without delay, although failure of the niche to disappear, or enlargement of the niche during treatment, is not necessarily evidence that the ulcer is carcinomatous, as Jordan and Boynton have shown. It may be benign but not curable medically.

CONCLUSIONS

If the clinical evidence does not point strongly either to benign gastric ulcer or cancer, and a competent roentgenologist makes a diagnosis of "lesion," medical treatment should be started only after the patient has been fully informed of the risk involved and that there is a 50 or 60 per cent chance of cancer being present. This should probably be done with great reluctance and with a readiness to abandon medical treatment for surgical treatment unless healing takes place promptly. In fact, prolonged medical treatment is seldom justified when the lesion does not promptly disappear even when one is reasonably certain it is benign, so long as skilled surgery offers a rapid restitution of health at a comparatively small risk.

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ACUTE PERFORATIONS OF STOMACH AND DUODENUM*

A STUDY OF 36 CASES

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THIS study, based upon 36 consecutive operated cases of acute perforation of the stomach and duodenum, was undertaken as a check on our own work and to determine, if possible, the end results from surgery which was performed according to our judgment at the time. Although this series of 36 cases is not large as compared with other representative series,[1,2,6,7,8] it is large enough to give suggestive data, especially in so far as these cases have been followed over considerable periods of time.

Acute perforations of the stomach and duodenum are frequent enough to rank high among intra-abdominal catastrophies, and the frightful mortality incident upon delay in recognition and operation emphasizes the responsibility of both the general practitioner and the surgeon in getting these cases to operation without a moment of unnecessary delay.

While the mortality rate may vary somewhat in the hands of different operators, it is one to be dreaded under even the most favorable conditions. To give a few illustrations from recent literature, we find that Shawan[1] reports 227 cases with 55 deaths, a mortality rate of 24.22 per cent; Graves[2] in an analysis of perforated ulcers in German clinics quotes 144 cases in the clinic of Professor Victor Schmieden, at Frankfort-on-Main, with a mortality rate of 26 per cent for perforations in the duodenal and pyloric regions, 38 per cent for those in the mid-stomach and 50 per cent for those in the cardia; Rhodes and Collins[3] report a 25 per cent mortality in 155 cases of acute perforation; Black[4] has a low mortality rate of only 8 per cent in 50 consecutive acute perforations; James[7] reports 75 cases with 18 deaths, a mortality of 24 per cent. Eliason and Ebeling,[6] in a comprehensive review of both foreign and domestic statistics, quote 74 perforations in three services of two Philadelphia hospitals with operative mortality of 47.2 per cent; also an average mortality rate published in this country from 1921 to 1933 taken from 44 sources of 25.9 per cent and a mortality rate taken from combined reports of 22 foreign clinics or individual operators of 22.6 per cent, based on 3121 operated cases from 1921 to 1932. The average mortality of the combined groups containing 5061 cases was 23.9 per cent.

The mortality rate in acute perforations has a closer relationship to the time factor than does most other commonly encountered surgical conditions. This relationship is illustrated by Eliason and Ebeling[6] in their combined statistics gathered from the United States and foreign reports. In cases operated within six hours, the death rate was only 7.5 per cent; from six to twelve hours there was a jump to 32.9 per cent; from twelve to twenty-four hours 35.4 per cent and from twenty-four to forty-eight hours 67.5 per cent with the rate remaining about the same after forty-eight hours.

The very rapid increase in the death rate during the second six hours should be especially noticed and is due, as are the later increases, to the fact that the early chemical peritoneal irritation is developing into a bacterial peritonitis. If the perforation is closed within the first two or three hours, there is only little likelihood of a real peritonitis developing. Loehr[9] in a series of tests found 90 per cent of cultures taken

* From the service of E. MacDonald Stanton, M.D., F.A.C.S. and Chas. W. Woodall, M.D., F.A.C.S., Ellis Hospital, Schenectady, New York.

from the fluid as it emerged from the perforations of the duodenum to be sterile and 82 per cent of the cultures taken from stomachs to be sterile. Other reports find lower averages of sterile cultures but they all show that the stomach, and especially the duodenal contents are, from a practical standpoint, only rarely highly infective. Consequently, if closures can be made promptly, the danger of peritonitis is not greatly in excess of that in elective operations where these organs are opened.

The question as to the advisability of performing a gastroenterostomy or other corrective surgery at the time that an acute perforation is closed has been the subject of considerable controversy and apparently has not yet been settled to the complete satisfaction of all concerned. A questionnaire submitted by Guthrie some years ago to prominent surgeons revealed the different opinions held by some men of equal reputation and ability. This same difference in opinion is illustrated in published articles from scattered sources. Thus Guthrie[10] reports 42 perforations with an operative mortality of 16.6 per cent, all of which were treated by simple closure and only 3 required subsequent gastroenterostomies; Mattingly[11] with a mortality of 14.2 per cent in 91 cases performed a primary gastroenterostomy in only 1 case, and only 4 cases were known to have required subsequent gastroenterostomies. Brenner[12] reported 27 perforations with a mortality of only 3.7 per cent following simple closure. Smith[13] in 41 consecutive perforations had a 12.1 per cent mortality, all but 2 of his cases being treated by simple closure. Searby[14] in 33 perforations had a death rate of 6.1 per cent, all the cases being treated by simple closure. Gilmour and Saint[15] report a 4.7 per cent mortality in 64 acute perforations, all but one case having a simple closure.

On the contrary, certain surgeons seem to advocate radical surgical procedure on all perforations if the time is not too far advanced. Harden[16] recently reported 16 perforations on which he had performed gastroenterostomies with one death, a mortality of 6.+ per cent. He was fortunate in operating all but 2 of these cases in from two to six hours. These 2 were eleven and twelve hours respectively. Butler[8] reports a series of 47 cases in which pyloroplasty was performed with a mortality of 6.38 per cent, the average time before operation being between six and seven hours. His conclusions are interesting and merit quoting in substance. He believes (1) that by all except experienced surgeons, a simple closure should be used, especially in private practice where there is a chance to supervise the postoperative and follow-up care of the patient; (2) that where the elapsed time is under six hours and the ulcer is duodenal and chronic, with moderate induration and deformity, excision of the ulcer continuing the incision through the pyloric ring and suturing transversely, is good surgery; (3) that if the ulcer is callous and the deformity great and the time is under six hours, a posterior gastroenterostomy may be performed; and (4) that in gastric perforations only a simple closure with possible cauterization or excision of the ulcer margin should be done regardless of the time of perforation.

We have felt that any additional surgery such as gastroenterostomy, excision of the ulcer or pyloroplasty performed at the time of the primary closure of a perforation added a definite risk to the patient and could only be justified by unquestioned benefits accruing therefrom. In determining the procedure to be adopted in the individual case as regards simple closure or closure associated with some other operative procedure, answers to the following questions must be taken into consideration. (1) What proportion of cases treated by simple closure will subsequently require gastroenterostomy and how long will be the intervening period before the secondary operation is required? (2) If all cases had been subjected to primary gastroenterostomy, how many would have had unnecessary operations and by the time the secondary operations were required,

how many of the unnecessary gastroenterostomies would have developed complications associated with the gastroenterostomy itself, such as jejunal ulcers? (3) By performing a gastroenterostomy or other major surgery at the time of closing a perforation, are you lessening the patient's chance of primary recovery? Difficult as these questions are to answer, they illustrate the reasons why to date surgeons are still divided as to their final decisions.

I find that in our own group of 36 acute perforations, 8 or about 23 per cent have subsequently developed an obstruction and have been reoperated. In all but one of these 8 cases, the period of relief from ulcer symptoms following the perforation was very brief and obstruction developed promptly. One went for fourteen years before developing obstruction, but for the other 7 the average time elapsed between the perforation and secondary gastroenterostomy was thirteen and one-half months. The fact that these cases divide themselves into two sharply defined groups: (1) a group of 23 cases in which either no evidence of obstruction developed or, as in the case of one individual, where it was delayed fourteen years, and (2) the group of 7 cases in which obstruction required gastroenterostomy operations in an average of approximately one year following perforation, suggests the possibility that there may have been at the time of perforation some clearly defined pathological differences characterizing these two groups. However, from our operative descriptions, no such classification can be made. Some indurated ulcers never developed obstruction and some apparently less indurated ulcers, did develop obstruction. Nevertheless, this only emphasizes the probable necessity of more searching observation in the future.

It is questionable whether draining the abdomen in acute perforations is of any benefit except possibly in the late cases. It is mechanically impossible to drain all surfaces that have become contaminated and the drains themselves act as irritating foreign bodies. In our series, we have drained only three times, once in a seventy hour case and in a thirteen and sixteen hour case. The sixteen hour case died from peritonitis thirty-six hours after operation.

Some of the data obtained from the study of our cases are summarized. I have often heard the opinion expressed that in perforated ulcers the first symptom of ulcer was likely to be the perforation itself. In our series this has not been so, for in only one of 36 perforations was this true. On the other hand, nearly one-half (15 of 36), had had symptoms for only three weeks or less. The balance had suffered stomach symptoms varying from a few months to thirteen years. There were 3 cases in which no definite time was given.

The duration of symptoms of perforation at the time when the patient was first seen by a surgeon is shown in the following table. The average time of operation would be about one hour later.

Time Seen	
1 to 6 hours	23
6 to 12 hours	2
12 to 24 hours	4
24 to 48 hours	1
48 to 72 hours	1
Over 72 hours	2
No time given	3
Total	36

The incidence of age and sex ran true to form. Ulcer is largely a disease of young adult and middle age males. Our 36 cases were between the ages of eighteen and sixty-five years with 28 under fifty years of age. There were only 3 women.

The anesthesia used was exclusively ether, except that in recent years ethylene was occasionally employed for induction. We have found that in upper quadrant work ethylene alone seldom gives sufficient relaxation. This is true more especially in such conditions as perforated ulcer where there is a board-like rigidity to overcome.

The pathology found at operation in 33 of the 36 cases originated in the pylorus or duodenum. In one case there was a perforation into the lesser cavity from the

posterior wall of the stomach and in the other 2 cases there were perforations of the cardia.

The operation performed in 31 of the 36 cases was a simple closure of the perforation with linen sutures reinforced by omentum stitched over the closure, if deemed necessary. The abdomen was then closed. In 3 cases, the same procedure was followed but in addition the abdomen was drained. These 3 late cases, one of seventy hours duration, had a large amount of abdominal fluid and peritonitis. In only one case was a gastroenterostomy performed in addition to the closure. The remaining case was the one in which there was a perforation into the lesser peritoneal cavity. This pathology was missed at the time of the operation, the only thing found being a diseased gall bladder which was drained. At autopsy the real pathology was discovered.

An effort was made to trace all patients regarding the development of subsequent symptoms. However, some of them were public ward cases who could not be located and no facts are available regarding their subsequent history. Of the 36 acute perforations, 5 died in the hospital, 5 have not been traced, and 26 were traced over a combined period of 187.5 years or an average of about 7.2 years.

The relief of stomach symptoms in these cases varied from no relief in 2 cases to fourteen years and in 3 others with an average relief of about four years. The recurrent stomach symptoms ranged from mild indigestion to real obstruction, and in 2 cases to secondary acute perforations.

Of the 26 traced cases, 10 were subsequently reoperated, one of them twice; two of these operations were for second perforations occurring respectively four and twelve months after the original perforation. The remaining 8 operations were for obstruction occurring at various periods from six weeks to fourteen years after the primary perforation. Five of the 8 obstructions developed within one year from date of perforation, 2 within three years and one fourteen years later.

DEATHS

The mortality in our series was 5 or 13.9 per cent. A review of these deaths shows that 2 occurred in cases which had been perforated over forty-eight hours, one over twenty-four hours, one under twelve hours and one with no recorded time. The unrecorded time case and the one under twelve hours were both gastric perforations; the other 3 were duodenal. A brief summary of these 5 deaths shows the following points.

Case 1. F. G., male, aged thirty-two years, nine days before operation had sudden severe abdominal pain for which he was given ½ grain morphine which was repeated in two hours to control the pain. Two days before operation he had recurrence of the acute pain. Operation November 1, 1914 revealed that all peritoneal surfaces below the level of the transverse colon were reddened, thickened and granular with loss of luster, but no free fluid and only occasional flakes of fibrin were present. The omentum was turned upward and was adherent over the gall bladder and the lesser curvature of the stomach. Beneath the omentum were scattered pockets containing from 2 to 10 c.c. of pus. In the right kidney pouch was a considerable collection of thin seropurulent fluid. The gall bladder was thickened and under tension. The gall bladder was drained of its contents of thick tarry bile. Vioform drains were inserted to the omental abscess areas and the right kidney pouch. Six days later this patient died and autopsy showed general peritonitis with a large collection of pus in the pelvis and multiple smaller pockets in other areas. There was a small perforation in the upper posterior surface of the duodenum lying against the common duct but no induration of the ulcer.

Diagnosis. Acute pyloric ulcer with subacute perforation and later rupture of abscess into the general peritoneum. The ulcer was not frankly open at time of the operation or autopsy although at some time there must have been considerable leakage of fluid chiefly backward into the lesser peritoneal cavity.

Case 11. T. L., male, aged twenty-seven years, sixty-six hours before operation had a sudden pain in epigastrium while riding on a

trolley. When first seen by a surgeon there was board-like rigidity and obliteration of liver dullness. He was operated at once and about 1500 c.c. of fluid and stomach contents were found in the abdomen. On the anterior surface of the pylorus was a perforation about 3 mm. in diameter, which was closed with linen sutures and omental graft. The lower abdomen was drained with tubes and vioform and rubber tissue drain inserted to the pylorus. The patient died thirty-six hours later from toxemia and peritonitis.

Case III. W. R., male, aged forty-two years, was first seen December 4, 1911 giving a stomach history dating back to 1908 of gas, vomiting, distress two hours p.c., food relief; he vomited blood once. Lately there were obstructive symptoms with delayed vomiting. Gastroenterostomy was done December 5, 1911, and an ulcer of the pylorus was found. He was next seen January 5, 1917 with history of severe stomach symptoms of vomiting, epigastric pain and loss of weight for the past month. One week later, January 13, 1917, he was operated and a large subacute perforation of a gastrojejunal ulcer was found. The pylorus was found to be patent with the old pyloric ulcer healed. The gastroenterostomy opening was closed after the gut had been separated from the stomach and the area drained. The patient developed a sudden severe epigastric pain on February 5, and the following day was reoperated, a fresh perforation being suspected. The old incision which was well healed except for two or three superficial foci of pus, was reopened. Exploration of the entire upper abdominal field failed to disclose any fresh perforation, but there was an early general peritonitis, the exact cause of which could not be determined. Both the upper abdomen and pelvis were drained but the patient died the following day from the peritonitis. An autopsy showed that a new ulcer, never before found by *x*-ray examination or very careful palpation at the operation three weeks before, situated on the posterior side of the duodenum, the perforation of which three weeks after the original operation for the perforating gastrojejunal ulcer, was responsible for his peritonitis and death.

Case IV. W. R., male, aged forty-two years, was first seen May 17, 1923, five hours after a sudden severe pain in the epigastrium accompanied by vomiting. He gave a history that for a "long time" he had had stomach trouble, nausea, burning, sour stomach and had taken much soda. At operation, a perforation of the greater curvature ¾ inch in diameter was found high up on the cardia. The belly was filled with fluid and partially digested stomach contents. A simple closure was done but he died thirty-six hours later from toxemia and peritonitis.

Case V. W. B., male, with no history obtained as to age, length of time of perforation nor anything else except that he had had a sudden abdominal pain and was admitted to the hospital with peritonitis. He was operated April 20, 1918, making a median incision. Air and much turbid fluid escaped from the abdomen. A perforation on the posterior surface of the stomach near the cardia was closed and the abdomen drained. He died six days later from peritonitis.

SUMMARY

A review of mortality statistics has been made in cases of acute perforations of the stomach and duodenum, covering large groups in both this country and abroad. The question of extensive surgery, such as gastroenterostomy and pyloroplasty performed at the time of closing the perforation, was discussed. Report was made covering 36 cases of acute perforation with 5 deaths in the service of Dr. Stanton and myself.

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SURGICAL LESIONS OF STOMACH*

IMMEDIATE AND LATE RESULTS IN ONE HUNDRED CONSECUTIVE CASES

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THIS article is based on an analysis of the immediate and late results in 100 instances of surgical lesions of the stomach in which operation was performed by ten different surgeons at the Reading Hospital from January 1, 1929 to October 15, 1935. Three surgeons operated upon only one patient of the series.

The data concerning the end results were obtained in many instances by personal examination; in the remainder, by a questionnaire sent to the patient, and the information was received from the patient, a member of the immediate family or from the family physician. The questionnaire was sent three months after the last patient was discharged from the hospital, all replies being received from all the patients.

IMMEDIATE RESULTS

Of the 100 patients, 82 survived and 18 died. The immediate convalescence of those who survived was generally excellent; most all had only a mild postoperative reaction. The average hospital stay was nineteen and one-third days.

Twelve of these patients had either preoperative or postoperative blood transfusions, usually by the direct method. One of the patients, with malignancy, had six blood transfusions. One patient, who had a posterior Polya resection, developed serious urinary retention and could not be catherized. A suprapubic punch cystostomy was performed, and in ten days the urine was passed normally and the suprapubic wound healed. In one instance there was a mild degree of wound disruption, which was promptly closed under local anesthesia and healed well.

Another patient had a mild type of lymph edema and phlebitis of one leg which cleared up completely.

TABLE I

PATHOLOGICAL PROCESS PRESENT

Pathological Process	Number of Cases	Number of Deaths	Mortality, Per Cent
Duodenal ulcer	36	4	11.
Perforated duodenal ulcer	24	8	3.
Gastric ulcer	5	1	20.
Perforated gastric ulcer	5	1	20.
Carcinoma stomach (perforated 1)	15	3	20.
Congenital hypertrophic pyloric stenosis	9	1	11.
Tuberculosis and sarcoma[7]	1	0	0
Duodenal and gastric ulcer	2	0	0
Syphillis with duodenal obstruction	1	0	0
Gall bladder disease and duodenal ulcer	2	0	0

TABLE II

MORTALITY IN RELATIONSHIP TO ANESTHESIA

Type of Anesthesia	Number of Cases	Number of Deaths	Mortality, Per Cent
Spinal	35	7	20.0
Spinal reinforced by ether	12	1	8.3
Nitrous oxide and ether	34	7	20.5
Local and ether	3	0	0
Ether (intratracheal 1)	6	1	16.6
Avertin and nitrous oxide	4	0	0
Local	6	2	33.3

* From the Surgical Department of the Reading Hospital. Read before the Berks County Medical Society, April 14, 1936.

TABLE III
MORTALITY IN RELATIONSHIP TO OPERATIVE PROCEDURE

Procedure	Number of Cases	Mortality	Mortality, Per Cent
Gastroenterostomy	46	5	10.8
Perforated ulcer, 29.			
Closure with drainage	14	5	35.7
Closure without drainage	2	0	0
Closure without drainage and appendectomy	1	1	100.0
Closure with drainage and appendectomy	9	2	22.0
Closure with gastroenterostomy and drainage	1	0	0
Closure with gastroenterostomy, drainage and appendectomy	2	1	50.0
Resection, 10.			
Polya	6	1	16.6
Billroth I and appendectomy	1	0	0
Billroth II	3	2	66.6
1, one stage; 1, two stage; another for perforated ulcer			
Fredet-Rammstedt	9	1	11.0
Pyloroplasty	2	0	0
Excision of gastric ulcer	2	0	0
Excision of gastric ulcer, gastroenterostomy and appendectomy	1	0	0
Gastrostomy	1	0	0

TABLE IV
COMPARATIVE MORTALITY OF SERIES FOR PERFORATED ULCERS OF VARIOUS AUTHORS

	Number of Cases	Number of Deaths	Mortality, Per Cent
Eliason and Ebling[2]	72	34	47.2
Rentschler[7]	29	8	27.5
Corff[1]	62	16	25.8
Trout[6]	41	9	22.0
McClure[3]	75	20	26.0
Shawan[5]	227	55	24.2
Rhodes and Collins[4]	155	39	25.0

Still another patient who had a perforated duodenal ulcer which was sutured, developed a quite constant postoperative cardiac arrhythmia both of the extrasystole and auricular fibrillation type. He was sixty years of age and weighed 180 pounds. His arrhythmia responded to cardiac medication.

In another instance in an overweight male, sixty years of age, who had a complete pyloric obstruction which required a posterior jejunostomy, there was annoying hiccough for six days, in spite of the fact that he apparently had no postoperative gastric retention.

One patient, who had had a perforated duodenal ulcer, developed a pleural effusion on one side; 600 c.c. of amber fluid were aspirated, and convalescence continued.

For the 18 who died considerable effort was made to save them. Table V will be an aid in the determination of the cause of death.

TABLE V
IMMEDIATE RESULTS
18 Deaths: 16 Postmortem Examinations

Perforated Ulcers
- 2 Extensive portal cirrhosis of the liver; one had marked abdominal ascites.
- 2 Perforated over 72 hours; had extensive purulent general peritonitis.
- 1 Subdiaphragmatic abscess; duodenal fistula.
- 1 Extensive generalized peritonitis; abdomen had been closed tight following closure of ulcer and appendectomy.
- 1 Myocardial degeneration on admission; appendiceal stump open with peritonitis in lower abdomen.
- 1 Shock; death within a few hours; no postmortem.
- 1 General failure.

Pyloric Stenosis
- 1 Accidental opening of duodenum at time of operation; duodenal and colonic fistulas; peritonitis.

Carcinoma
- 1 General failure and collapse; death within a few hours; no postmortem.
- 1 Bilateral pneumonia.

Duodenal Ulcers with Obstruction
- 4 Pneumonia; one following second stage Billroth II operation, and another following a gastroenterostomy three years after a closure of a perforated duodenal ulcer.

Gastric Ulcer
- 1 Massive pulmonary embolism on day of hospital discharge.
- 1 Peritonitis; leaking gastroenterostomy.

END RESULTS

Of the 82 who left the hospital, 57 stated that they had no return of symptoms and were in good health; 2 of these had secondary gastric operation for a gastroenterostomy six months after the closure of a perforated duodenal ulcer and appendectomy.

Another had a reperforated duodenal ulcer and had, as his secondary operation, pylorectomy and posterior gastroenterostomy.

Another patient had a subtotal thyroidectomy for a toxic adenoma of the thyroid.

Still another patient had repair of a small abdominal hernia which developed at the site of the stab wound drain in the lower abdomen following closure and drainage of a perforated duodenal ulcer.

Nine state that they are markedly improved but that at times they have some return of their symptoms. Of these 9 patients, 6 had perforated ulcers. Of the perforated ulcers, 4 were duodenal, and the operation in all 4 was closure of the ulcer and abdominal drainage. The other 2 had perforated gastric ulcers and were treated, in one instance by closure and posterior gastroenterostomy, and in the other by excision of the gastric ulcer and gastroenterostomy.

The 3 other patients who are markedly improved, but at times have some return of symptoms, all had duodenal ulcers, complicated by obstruction for which posterior gastroenterostomy and appendectomy had been performed.

Two patients had no improvement; one had a small duodenal ulcer excised with pyloroplasty and a cholecystectomy for cholecystitis; the other had a posterior gastroenterostomy for adhesions and a possible peptic ulcer. There had been gastrointestinal hemorrhages, and at the time of operation there was also some enlargement of the spleen. In a prior operation, a cholecystectomy had been performed. A third operation was performed one year after the gastroenterestomy, releasing some adhesions. Nine months after this third operation there is no improvement in the condition of the patient.

Of the remaining 82 patients who left the hospital, 14 had died; 10 as a result of malignancy of the stomach present at the time of operation; one each of nephritis, insanity, pulmonary tuberculosis, and the last one died from pneumonia following a posterior gastroenterostomy two and one-half years after the operation for closure of a perforated duodenal ulcer.

CONCLUSIONS

1. A detailed history and a thorough physical examination, as well as the indicated laboratory tests, are paramount requirements before a patient should be subjected to gastric surgery.

2. Gastric surgery is contraindicated unless gastric pathology is found at the operation.

3. Not much, if anything, is gained by performing a gastroenterostomy for inoperable malignancy of the stomach.

4. There is a widening sphere for more radical surgery, and this is also supported by the late results.

5. In operating for perforated peptic ulcer the first consideration is the life of the patient and, therefore, the operation in most cases should only consist of closure of the perforation with, or without abdominal drainage. The author feels that appendectomy in these cases is wrong.

6. Considering the diversity of lesions and the multiplicity of surgeons, the immediate and late results are considered fair.

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ACUTE INTESTINAL OBSTRUCTION*

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CINCINNATI

OF all the ailments to which the human body is heir, there is none in which early diagnosis and judicious choice of treatment are so imperative as in acute intestinal obstruction. The activities of the intestinal tube are so highly specialized that they cannot be taken over by any other organ or system of organs in the event of their interruption by disease or sudden accident. It is largely for this reason that the mortality of acute obstruction of the bowel has stood at 40 to 50 per cent, or even higher, for many years.

Thus Miller,[1] in 1929, after a study based on 343 surgical cases of intestinal obstruction in two New Orleans hospitals, reached the conclusion that the mortality usually stated to be between 30 and 40 per cent was actually between 55 and 65 per cent, and gave as the chief reason the delay in diagnosis and treatment. Among other authors reporting the percentage of mortality are Rentschler[2] (1934) with a 41 per cent mortality in 100 cases studied, Cornell[3] (1932) with 51.48 per cent, Seelaus[4] (1931) 53 per cent and Vidgoff[5] (1932) 51.48 per cent.

Moss and McFetridge[6] (1934), making a comparative study of 511 cases of obstruction in the Charity Hospital in New Orleans, found that a mortality of 70.7 per cent in the five year period between 1923 and 1927, when modern methods had not yet been introduced, had given way to a mortality of only 31.7 per cent in the three year period 1930–1932. Since adoption of the modern conception of treatment, with preoperative decompression, hypodermoclysis to replace lost chlorides, and immediate relief of obstruction by temporary enterostomy or colostomy followed at leisure by whatever radical procedure was correctly indicated, Bartels[7] (1934) in a study of 110 cases of carcinoma of the large bowel noted that of 12 patients who were suffering with acute obstruction of the colon 7 had died during their period of hospitalization after operation, a mortality of 59.5 per cent. Vidgoff[5] reported (1932) a hospital mortality of 68 per cent in 15 cases of obstruction due to carcinoma.

I am convinced that the principal reason for this formidable percentage of fatal results lies in the fact that the surgeon has too often rushed his patient to the operating room without first making a diagnosis of the cause of obstruction and without instituting suitable preoperative treatment with a view to relief of the tension in the suffering gut before subjecting his patient to radical operation. The patient, already fighting for his life, with depleted body fluids and in a state of chemical disequilibrium, with the gut dangerously distended or possibly strangulated and his general bodily condition one of toxemia, has been put under ether anesthesia, his abdomen widely opened, and a resection of the intestine performed immediately and followed by anastomosis of the sectioned gut. Too often the result has been shock beyond his strength to bear. It is not surprising, then, that the mortality has been so high as to give pause to the surgeon, and to make him hesitate to expose his patients to such grave surgical risks.

We have adopted recently a definite form of procedure which is designed to minimize these risks. The description of our technique is given in the hope that these modern methods of treating this grave condition may be more generally adopted. Our method is not novel, but we believe that we have succeeded in correlat-

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ing and systematizing the routine treatment of these baffling cases in a manner that is most encouraging and that gives hope that a lowered mortality will result. The outlined method with its preconceived technique, has given most gratifying results in a way of a lowered mortality, both primary and secondary, and has relieved me of the anxiety and uncertainty of the course that should be followed in cases of acute intestinal obstruction.

Our first contention is that sufficient time should be given to these cases to try at the very outset to make a diagnosis as to their cause. This can be done with safety and even to the advantage of the patient, because with supporting measures he can be put into better condition to withstand the operation without jeopardizing his chance of recovery. This does not indicate that any time should be lost before proceeding with treatment, but that we are better equipped with preoperative means for controlling vomiting, for keeping the gut from excessive distention, for replenishing lost body fluids, for detoxifying the patient and for building up his general bodily resistance until such time as the appropriate operative measures can be instituted safely. Time is not as important in acute intestinal obstruction as in perforation, where bacterial invasion, which brooks no delay, is to be outraced.

IMPORTANCE OF EARLY DIAGNOSIS

Cases of acute obstruction may be divided into those of the small and of the large intestine, but the more important thing is to learn at the outset in which portion of the intestine the blockade has occurred.

The symptoms and the clinical course of obstructions of the large intestine differ rather strikingly from those of the small gut. This is partly because of anatomic differences in the structure, form and arrangement of the two parts of the intestinal canal, and partly because of the different functional roles that they fulfil in the body economy. While the duties of the colon are mainly those of a sewer, the small intestine has the work of discriminating among the materials sent down to it by the stomach, and then of assimilating and absorbing those that are to be retained. These are activities that call for a series of chemical processes of the greatest delicacy and of the highest importance.

It has long been observed that the higher the blockade occurs, the more rapidly are its results fatal. Various causes have been assigned for this, the chief of which appears to be the close topographical relationship of the upper part of the small intestine to the stomach, bile ducts and pancreatic duct. Owing to this the vomiting reflex that is so conspicuous and so early a phenomenon in obstruction at this site robs the body of fluids and indispensable chemical materials contained in the secretions from these organs before they have had an opportunity to be absorbed by the bowel. In these high obstructions, after forty-eight hours have elapsed, the blood urea rises, the amount of plasma chlorides diminishes and the carbon dioxide combining power of the blood is increased, causing serious detriment to the body as a whole.

This is not the case when the obstruction is low down in the small intestine, where the absorptive power of the gut is relatively intact and the loss of secretions from other digestive organs is comparatively slight. This depletion is felt still less when the blockade is beyond the ileocecal valve. It is generally agreed that obstructions in the colon are less fulminating than in the small intestine and are not so rapidly fatal. Patients may even survive for two weeks with a fair degree of comfort while waiting for operative relief of an obstructed colon, provided, of course, that the obstruction is a simple one and that strangulation or volvulus is not present.

For these reasons it is, I repeat, of the greatest practical importance that it be recognized promptly whether the obstruc-

tion is in the large or the small intestine; and, if it is in the large bowel, whether or not the cecum is involved. This will practically always be the case when the occlusion is in any part of the large intestine, for the ileocecal valve is such a powerful check-valve against regurgitation of any material from the colon into the small intestine that the cecum is bound to bear the brunt of even an obstruction as far removed as in the sigmoid. It is, therefore, almost invariably found distended with gas and fecal matter when the colon lacks a free outlet below due to whatever obstruction may exist.

Obstructions occurring in the small bowel may be caused by postoperative adhesions, intussusceptions, hernia, foreign body, gallstone, stricture, tumor or diverticula. When located in the large intestine, the causes most frequently observed are volvulus and tumor, particularly carcinoma of the colon. Mesenteric thrombosis may cause gangrene with resultant obstruction in both large and small bowel.

Simple obstructions are to be differentiated from those in which there is strangulation. In the latter there is obstruction not only of the lumen of the gut but also of the blood supply, especially the venous, resulting in hemorrhage within the gut and necrosis of tissue. In strangulation obstructions reduction must be prompt, before there has been wholesale necrosis of tissue leading to peritonitis.

The most frequent cause encountered is tumors of the large intestine, usually of malignant type, and as a rule in persons over forty years of age. The patients present themselves with a distended abdomen, regurgitant vomiting and intermittent colicky pains unaccompanied by abdominal tenderness or rigidity. These tumors are found more frequently in the lower segment of the descending colon, sigmoid or rectum, but may be met anywhere, the ileocecal valve being especially a site of predilection. These are the cases in which I am especially interested and which to date present a formidable mortality, still bordering on approximately 50 per cent.

The acute attack that brings the patient to the surgeon for relief may be the termination of a chronic obstruction of a partial nature, of which the patient may not even have been aware. He only knows that he has had an increasing obstipation, which suddenly becomes associated with colic. These acute-on-chronic intestinal obstructions are so regularly caused by carcinoma of the colon that for practical purposes they may be regarded forthwith as large bowel obstructions from malignant tumor of the colon or rectum.

Our first concern, then, when a patient arrives with an obstructive bowel condition, is to establish the site of the obstruction, whether in the large or small bowel, for the treatment will vary according to the findings. Vomiting occurs early in high obstructions and late in low ones. If the small intestine is blocked, the pain is in the region of the umbilicus; if in the large intestine, it is at the site of the obstruction, wherever that may be.

PREOPERATIVE MEASURES

The initial measures will be the same in both kinds of obstruction. Our method of handling these cases is the following:

1. Upon the patient's admission to the hospital, a continuous gastric suction tube of the Levine type is inserted intranasally into the stomach or duodenum, for the purpose of lessening the distention and decompressing the alimentary tract.

This adaptation of negative pressure through the use of continuous suction siphonage, as advocated by Wangensteen[8] and others in cases of intestinal obstruction, has a strongly decompressive action upon the stomach and the upper intestinal tract. According to that author, the amount of fluid and gas aspirated by suction, as indicated in the graphs taken, correlates fairly directly with the degree of obstruction present. The continued return of a large amount of fluid and gas indicates that the obstruction is of high

grade. This decompression is particularly useful in mechanical adhesive obstructions, in which its effect is sometimes to overcome the obstruction itself without further measures; but in obstructions of a type in which this cannot be expected, its use is nevertheless a valuable auxiliary in the reduction of intra-enteric pressure, both relieving the colic and reducing the distention so that palpation for tumors becomes possible.

During the maintenance of this suction, the patient's condition should be watched carefully, so that enterostomy, if needed, may not be delayed too long. The tube can, however, be left in the stomach during operation and thereby lessens the chance of the patient's aspirating vomitus.

2. Glucose in normal saline solution is given subcutaneously to counteract the dehydration that results from the frequent vomiting, and to replace the depleted chlorides. References has already been made to the loss of valuable chemical constituents in the gastric, duodenal, and pancreatic juices through the early and copious regurgitant vomiting in high obstructions. This loss of substances that are essential to life must be counteracted by saline solution, which exercises some of the virtues of a specific for fluid loss. Although in low obstructions loss of fluid may be slight, since vomiting is not always present, nevertheless saline solution should be introduced subcutaneously as a routine treatment in all types of obstruction.

3. A digital rectal examination reveals whether there is an impaction of feces or whether any accessible tumorous growth exists in the rectum. Proctoscopy and sigmoidoscopy may be in order, if there are any indications pointing to the lower colon or rectum as the site of occlusion. If nothing is felt, an enema is given and a "flat plate" *x*-ray picture taken, i.e., one with barium or other opaque substance, with the patient in the dorsal or the standing position, according to his condition. This use of the plain *x*-ray films for diagnosis in acute intestinal obstruction, common in Germany since Schwartz[9] first employed it in 1911, was not seriously advocated in this country until the late 1920's. I have found it to be of very great value, affording a most important means of recognizing the site of the obstruction. It is worthy of note that in normal adults and in children over three years of age, gas in the alimentary canal is not visible in the *x*-ray picture, because it is so closely mixed with the fluid. In case of obstruction, however, the gas separates and becomes visible in the *x*-ray picture, where it constitutes a clear indication of intestinal stasis. Below the point of obstruction no gaseous shadows are seen.

This *x*-ray evidence exists in laboratory experiments within four to five hours after the obstruction appears, according to Wangensteen.[10] We have found that with the knowledge obtained from the *x*-ray plate and with a history of the case, the patient's age, and whether or not he has been operated previously, has suffered loss of weight, etc., it is possible to approximate a correct diagnosis. If the gas is in the small intestine, it will be centrally located in the roentgenogram, with the long axis of the shadow running transversely. If, instead, the gas is seen at the lateral borders of the abdomen, its location may be presumed to be in the colon. In such case the long axis is ordinarily vertical. The walls of the intestine appear thicker and often it is possible to see the outlines of the haustral markings.

Two characteristic arrangements of gas in the small intestine have been observed: (1) a feathery, herring bone type, due to the prominence of the folds of Kerkring, which is clearly suggestive; and (2) a pathognomonic arrangement, in which the loops are seen lying parallel to one another, like the steps of a ladder. This ladder arrangement comes late and may not yet be in evidence when the first *x*-ray picture is taken. One should not wait for it in reaching a diagnosis. If the evidence of the plain flat *x*-ray plate points to the colon

as the site of obstruction, a barium enema is useful as a supplementary procedure to establish the diagnosis.

4. The stethoscope has been an invaluable aid in localizing the presence of collections of gas above an obstruction. Auscultation elicits vigorous peristalsis just above the block, as the expression of a bowel under tension lashing itself against a barrier that it tries vainly to break. Loud bubbling noises reaching their maximum intensity just at the peak of a colicky, intermittent pain confirm the presence of a mechanical occlusion. In order to establish the diagnosis, we have repeated this auscultation at frequent intervals, visiting the patient once an hour during this stage of the obstruction, with a view to checking the coincidence of these gurgling sounds with the waves of intermittent pain. In some cases these waves are the expression of such an exaggerated peristalsis that they can even be recognized without instrumental aid, as they travel across the wall of the abdomen. I do not hesitate to say that I believe many lives now lost could be saved by a judicious use of the stethoscope and roentgenograms in the prompt diagnosis of these cases.

It need scarcely be said that no morphine is ever administered until a diagnosis of obstruction has been made and the site approximately located, since it clouds the symptoms and falsifies the clinical picture, with the result that it misleads the diagnosis.

ANESTHESIA

In the choice of an anesthetic we have usually preferred a spinal anesthesia, if there are no contraindications. Inhalation anesthesia finds no indication in these cases, where the danger of vomiting and possible aspiration of gastric contents is so great. The toxic condition in which so many of these patients reach the surgeon is another reason why local or spinal anesthesia is the more advantageous procedure, far safer for the patient. We have found that 100 mg. procaine is sufficient for a long exploratory incision, or 75 mg. if the incision is low, as for a cecostomy.

PROCEDURE FOR THE SMALL INTESTINE

If the obstruction is in the small bowel, a long right rectus incision is made, after which the cause is determined and the necessary relief given. This will generally be a preliminary enterostomy for immediate relief of intra-intestinal tension, to serve until such time as a more radical procedure may be indicated for removal of the obstruction and restoration of the intestinal continuity. If, however, the obstruction is one of a strangulating nature, we proceed to reduce it, since in obstructions of this kind even minutes of delay count. Gangrenous loops, if present, must be pulled out and any contamination of the peritoneum that may have occurred must receive attention with all promptitude.

We never, however, perform an anastomosis at this emergency stage but pull the bowel out through the skin incision, leaving a temporary fistula as in simple obstructions after removal of any parts that may show signs of necrosis.

For the obstruction in the large bowel, have formulated a different procedure, and it is this type of procedure in which I am at present particularly interested.

TREATMENT OF OBSTRUCTIONS OF LARGE BOWEL

If we are reasonably sure that the obstruction is beyond the ileocecal valve, we make a right gridiron incision sufficiently large to admit the hand. With care not to allow evisceration, the hand is introduced and the site and type of obstruction are determined. A size No. 26 Pezzer catheter is next inserted into the cecum, usually with two pursestring sutures of linen. If the appendix is readily available, this is removed and the catheter inserted through the appendicostomy opening, which is an ideal relief of distention. If, however, as frequently occurs, the

appendix cannot be easily delivered because of the distention of the cecum, the catheter is placed directly into the cecum.

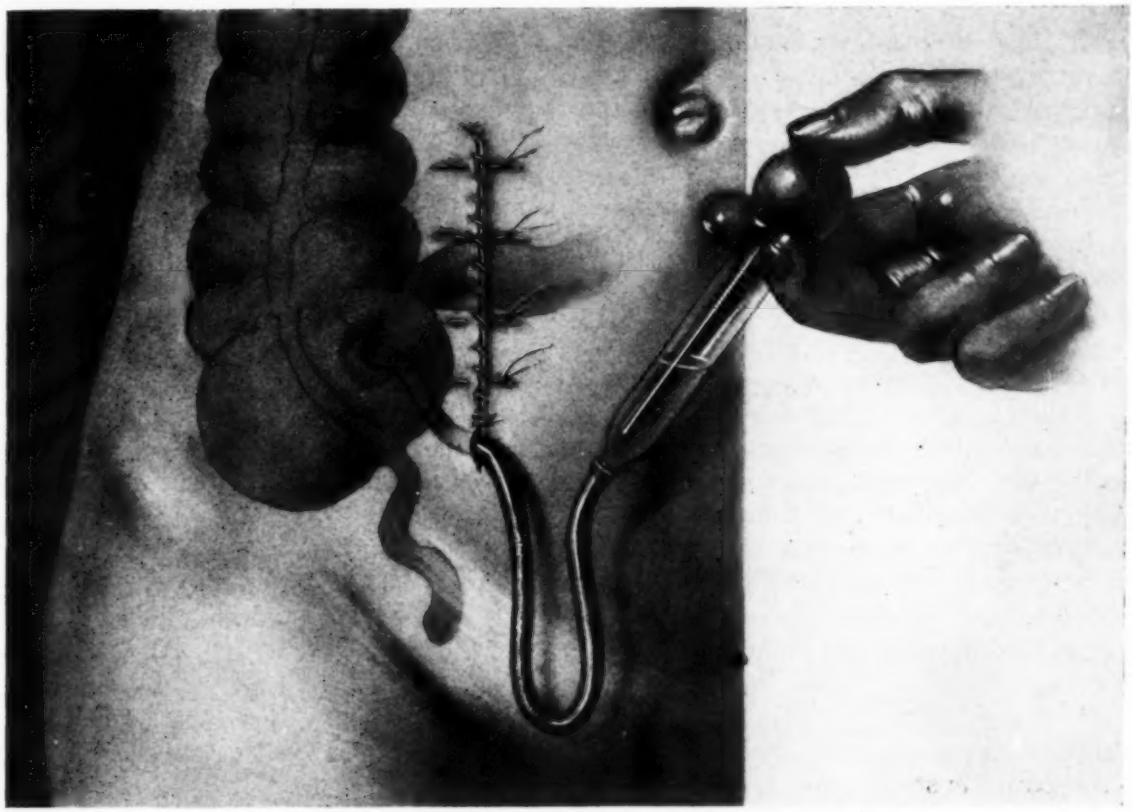

Fig. 1. Catheter in situ irrigated with saline using asepto syringe.

The wound is then closed and the patient returned to bed. The Levine stomach tube is left in place until the distention sufficiently subsides. Meanwhile glucose and saline solution, or saline solution alone, continues to be given subcutaneously daily. Fluids may be given by continuous venoclysis if this is thought necessary.

The catheter left in situ is irrigated almost immediately with saline solution, using an asepto syringe, as shown in Figure 1. This serves to dilute the cecal contents and permits free drainage. By this method, giving the irrigation two or three times a day, the obstruction is overcome and the toxemia held in abeyance. When the distention is sufficiently relieved, the stomach tube is removed and fluids are given by mouth. There is now no reason for any undue haste. With the tension relieved and the stoppage overcome, the patient may be given plenty of time to get back his strength before further measures are instituted for restoring the continuity of the bowel or for removal of a tumor. As fluids are retained, the diet is gradually increased, until a reasonably regular diet may be given. With the cecostomy properly functioning, this is easily possible, as we have demonstrated in many cases.

The second stage of course consists of radical surgery, the nature of which will depend upon the location and type of the obstructing lesion. It is advisable to reserve the second operation for two or three weeks in order to allow plenty of time for the system to resume a normal function. The cecostomy tube remains in situ, throughout the second or the third procedure, if there should be a third, and acts as a safety-valve. The first operation also confers an immunity upon the peritoneal cavity, making the secondary procedures less formidable.

CONCLUSION

It has been my impression, not only from my own experience but also from watching others in various clinics operate upon these cases, that complications upon the operating table, such as losing control of the distended bowel, contamination of the peritoneum in trying to suture the distended loops, shock from evisceration and rough handling, trying to do too much, etc., could be avoided by the adoption of a preconceived technique. I believe that we should err on the safe side, and that in very desperate cases we should make it a rule to do as little as possible, since these patients, owing to their toxic condition, have little resistance and stand surgery poorly. By the consistent use of the supportive measures that I have outlined, we have succeeded in reducing our mortality figures and in restoring to reasonably good health a very gratifying percentage of our cases of acute intestinal obstruction.

SUMMARY

1. The mortality from acute obstruction of the bowel is still formidable.

2. The principal reason for this large mortality is the delay in reaching a diagnosis and instituting preoperative measures for relief of distention and dehydration.

3. Under no circumstances in these grave cases should an enteroanastomosis be performed at the same sitting with an enterostomy or colostomy.

4. A method is outlined that has given excellent results with an improved mortality.

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CLINICAL ASPECTS OF MESENTERIC ADENITIS*

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MESENTERIC adenitis is an infection of the mesenteric nodes, occurring most commonly in children, particularly during seasonal epidemics of upper respiratory infections and if acute, assumes the aspects of an acute abdomen, in most instances resembling appendicitis.

Although there is a trend at the present time to subordinate clinical interpretation to *x*-ray and laboratory methods as a means of diagnosis, there are many pathologic entities which still depend upon the acumen of the well trained clinician for a diagnostic solution. Mesenteric adenitis is distinctly within the realm of clinical medicine.

The earlier accounts of this condition are to be found in the English literature. Carson[1] in 1918, and Struthers[2] in 1921, gave a comprehensive description of this entity, but do not distinguish between tuberculous and non-tuberculous adenitis. As a matter of fact, the English writers, and some in this country, believe that tuberculosis is the actual etiological factor in this disease.

Maurice Richardson, in 1900, reported before the American Surgical Association several cases of successful removal of tubercular glands from the ileocecal region, the first operation being performed in 1895. J. W. Elliot, likewise, removed tubercular glands from the mesentery. In 1920, Wilensky[3] reported 3 cases of mesenteric adenitis of non-tuberculous origin, and three years later stated that "mesenteric lymphadenitis is a syndrome which has in recent years established itself as a definite clinical entity." In 1921, Brenneman[5] called attention to abdominal pain in children occurring during epidemics of upper respiratory infections due to mesenteric adenitis. In 1929, Freeman[6] stated: "As far as I am aware, my own contribution in 1923 was the first in this country dealing with the surgical significance of the chronic form of the disease, although Wilensky published a paper in 1920 dealing with the acute inflammatory form limited to the ileocecal angle."

Mesenteric adenitis is discovered during abdominal explorations in proportion to the curiosity of the surgeon and his knowledge thereof. Gulecke,[7] of Jena, mentions that mesenteric adenitis is present in 13 to 30 per cent of all laparatomies. Bell writes: "When surgeons are on the look-out for the presence of diseased glands, larger numbers will be demonstrated."

According to Krause,[8] mesenteric nodes range between 100 and 200, while other anatomists counted as many as 220. They are arranged in three groups: (1) located close to the mesenteric attachment; (2) in the midmesenteric portion; and (3) in the root of the mesentery. The nodes are small, pea or lentil sized, pale, flat, movable, and are usually not noticeable during ordinary explorations. The majority of nodes are close to the ileocecal sector. The lymph flow from the intestinal mucosa and Peyer's patches is directed toward the mesenteric nodes and from there into the thoracic duct. The lymphatics of the appendix drain first in the prececal and retrocecal nodes, and after meeting the lymph current from the cecum, they finally empty into the ileocecal nodes.

Etiologically speaking, the opinions are divided between the tuberculous and non-tuberculous origin, although since the publications of Wilensky and Brenneman,

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the non-specific origin of this disease is definitely established.

Struthers[9] in 1921, reported 4 cases of mesenteric adenitis, 3 of which were tuberculous. He firmly believed that the infection was either pure tuberculosis, or that in some instances it was a mixed infection. The proneness of young children to tuberculosis explains the frequent invasion of the mesenteric nodes, which heal in most instances, but are subject to occasional flares on account of mixed infections. The incidence of mesenteric tuberculosis varies greatly according to many writers. Cornet, believes that tubercular nodes are found in every child during exploratory operations. Still found enlarged mesenteric nodes in 59 per cent of all postmortems in children. Osler and McCrae, analyzing the postmortem of Bovaird from the Mt. Sinai Hospital of New York, put the incidence of tuberculosis at less than 1 per cent. Braithwaite, who holds tuberculosis responsible for all cases of mesenteric adenitis, admits that the statistics vary in different localities and in various countries. The partisans of the tuberculous etiology trace the origin of the infection to infected cow's milk and consider all infections to be of the bovine type. Freeman found tuberculosis present in several of his cases of mesenteric adenitis, both histologically and by animal inoculations, and concludes: "I am inclined to believe, however, that if a sufficient number of glands have been tested, a large majority would have been found to be tuberculous." The inability of the laboratory to find tubercle bacilli is explained by the fact that organisms are either too few in number, or that they are dead. The cases reported by Wilensky, Brenneman, and my own cases have no relationship to tuberculosis. There are a great many other etiological factors in mesenteric adenitis, and although not all of equal importance, I shall enumerate them for the sake of completeness: neurotic types of children; lymphatic constitution (Heuser); habitual constipation (Pribram); chronic constipation (Carson); rickets (Elman); influenza (Pribram, Colmer, Edelman, Schmieden); throat infections (Brenneman); appendicitis (Pribram); intestinal parasites (Heuser, Pribram, Gulecke, Brüning); Hodgkin's disease (Symmers). In a case of Wagner's,[10] a blow to the right abdomen caused an inflammation of the cecum with marked mesenteric adenitis. Intestinal parasites were present in several instances. According to Brüning,[11] the inflammatory changes in the cecum and the associated adenitis were due to ascarides. Heuser,[13] of Basel, believes that several types of parasites, such as oxyuris, ascaris, and trichocephalus are responsible for adenitis. In one of my recent cases, this etiology was present. A boy, ten years old suffered for about one year with paroxysms of abdominal pains associated with nausea and vomiting, yet the picture did not conform to any of the known abdominal complexes. Exploration revealed the presence of chronic appendicitis and mesenteric adenitis. The pathologic report read: "Chronic appendicitis, mesenteric adenitis, and numerous pinworms." All symptoms disappeared promptly after the operation.

Although we have recorded the various etiological factors, we are mainly concerned with only two: upper respiratory infections and appendicitis. The relationship between upper respiratory infections and abdominal pain in children has been clearly and forcefully brought to the attention of the profession in this country by Brenneman. He stated that during certain epidemics of upper respiratory infections, abdominal pain is present in nearly 25 per cent of all cases. Curiously enough, most of the children with throat infections will complain little or nothing of their throats, but invariably point to the umbilicus and when questioned, they answer, "The pain is in my stomach." Abdominal pain in the course of epidemics of throat infections may even attack several members of the same family. The height of the season is from December to May, the highest peak

being in February. According to Brenneman, the abdominal pain in children "is perhaps the most frequent abdominal pain that comes to the doctor's attention in children beyond the period of infancy." Brenneman, considering the two possible avenues of infection, by way of the blood stream or by direct transmission, favors the latter. The absence of generalized adenopathy speaks against the former. He is inclined to believe that there is a selective localization of the infection in the colon or small intestine, even though the organisms have either been killed or attenuated by the influence of the gastric juice. The mesenteric nodes are secondarily involved, very much like the involvement of cervical and retropharyngeal nodes in throat infections.

Abt[13] summarizes the matter by saying: "Even as the cervical glands are involved secondary to throat infections, so there is good evidence that indicates that the abdominal lymph glands are also involved, and that the latter secondarily produce intestinal irritation with pain and vomiting."

Goldberg and Nathanson[14] report 16 cases of mesenteric adenitis from the Surgical Service of the Michael Reese Hospital, 11 of which gave a history of upper respiratory infection. Influenza is regarded by many clinicians as an important etiological factor and may either precede or may be associated with mesenteric adenitis. Mesenteric nodes have been found to be involved in influenza by Edelman, Schmiedem and others. Strümpel, in 1918, described the intestinal type of influenza. During the influenza epidemic in 1918 in Germany, Schmiedem noticed the association of a subacute type of abdominal symptoms which was recognized as an abdominal reaction to a systemic infection and, as such, these cases were not operated.

The role of a pathological appendix as a cause of mesenteric adenitis has both partisans and opponents. Mühsam[15] believes that mesenteric adenitis is a primary lesion, and that if the appendix shows pathologic changes, it is involved secondarily. Gulecke, at the German Congress of Surgery in 1924, denies the existence of primary mesenteric adenitis and insists that it is always secondary. Pribram[16] thinks that mesenteric adenitis is always secondary to some intestinal lesion and not infrequently secondary to pathologic changes in the appendix. The intestine and the appendix may be grossly normal at the time that mesenteric adenitis is apprehended, nevertheless, it suggests that the original lesions have healed and that the mesenteric response persisted. Pribram states that although the appendix may have been the starting point of mesenteric adenitis, the removal of the appendix may have no influence upon the retrogression of the enlarged nodes, if the appendectomy is performed late.

On the other hand, Wilensky and Hahn[17] state that mesenteric adenitis is practically never present in appendicitis, since cases of adenitis showed no gross changes in the appendix, and therefore, there is no etiologic relationship between the two. In my own cases, the appendix, to all appearance was normal, except those cases which were very acute and in which the entire small intestine, cecum and appendix, showed inflammatory changes. Heuser, of Basel, likewise, found little or no changes in the appendix in these cases.

There are difficulties which arise from the etiologic relationship between the nasopharyngeal infections and appendiceal pathology on the one hand, and upper respiratory infections which involve only the mesenteric nodes, without affecting the appendix itself. The fact that organisms from infected tonsils metastasize in the appendix seem to be fairly well established. Kirshenmann[18] is perhaps a bit dogmatic when he says: "Appendicitis is a complication of tonsillitis in the same sense as is rheumatic fever and endocarditis," and concludes: "Appendicitis in children is a complication of upper respiratory infections." When, then, do mycotic agents from nasopharyngeal infections invade the appendix and when do they attack the mesenteric

nodes? It is very likely that certain strains of organisms may concentrate upon the cecum, Peyer's patches or the lymphoid follicles of the appendix and that mesenteric adenitis is a subsequent event. It is also possible that by a process of selective affinity, some organisms, particularly during the severe first attack, may invade the mesenteric nodes only. The diagnostic confusion between appendicitis and mesenteric adenitis may be readily understood, since one may be the sequence of the other or be involved interchangeably. As stated before, normal nodes are not visible during ordinary explorations, as they are pale and small and are covered by the yellow and thick mesenteric leaves. If pathologic, however, the nodes appear as reddish, lenticular enlargements, which project beyond the mesenteric surface, varying in size from a pea to an almond. The enlargement is not uniform in all groups, some being larger than others. If the nodes of the ileocecal sector are the largest, it suggests that the infective irritant originated in the ileocecal structures. The inflamed nodes are freely movable, they are not covered with fibrinous exudate, and the adjacent peritoneum is not inflamed. Hedinger, who examined Heuser's material, describes the nodes as having a thin capsule with a slight lymphocytic infiltration; narrow sinuses in some instances, and enlarged in others. In their lumen are found normal cells of the reticulum, often numerous desquamated sinus endothelia and a few leucocytes. The lymph follicles are marked with germ centers, indicating a picture of chronic hyperplasia. Doerr, from the Hygenic Institute of Basel, found practically no organisms in inflamed nodes. He never found pus cocci and found Bacterium coli only twice in 25 cases. Guinea-pig inoculations and antiformin search for tubercle bacilli gave invariably negative results. Staphylococcus and Streptococcus hemolyticus have been isolated occasionally from mesenteric nodes, which proved to be morphologically identical with the organisms obtained from the throat of the same patients. Mesenteric nodes from 15 cases were submitted to the laboratory and without exception all reports read: "Acute nonspecific hyperplasia." Similar laboratory reports are quoted by Wilensky and Hahn.

It must be borne in mind, however, that early tuberculosis of the lymph nodes exhibits the histologic picture of lymphatic hyperplasia and cannot be distinguished from it. On the other hand, in tuberculosis of the lymph nodes, caseated or calcified nodes frequently will be found besides the mere hyperplastic ones.

Wilensky and Hahn classify mesenteric adenitis in four groups: (1) simple mesenteric adenitis; (2) suppurative mesenteric lymphadenitis; (3) tuberculous mesenteric lymphadenitis; and (4) terminal stage of mesenteric lymphadenitis.

While one must admit that mesenteric adenitis does not offer a clear cut clinical picture which one can easily recognize, nevertheless, it has definite aspects by which one can at least suspect it.

Patients afflicted with this condition are usually children between the ages of five and eleven years. They are often pale, thin, and on routine examination one invariably finds large tonsils, adenoids and palpable cervical lymph nodes. Many children give a history of "stomach trouble," which may date back to the period of early infancy. Some children complain of headache, drowsiness and some refuse their breakfast. Abdominal pain is the most conspicuous symptom in this syndrome. Its onset may be sudden and of short duration, disappearing as rapidly as it occurred, a fact observed by Carson. All grades of pain, from the very mild to the most severe may be present, so that some children scream. The pain is most commonly located in the right iliac fossa, it is invariably referred to the umbilicus, and in exceptional cases may be situated in the epigastrium, or even in the left iliac fossa. Steinberg described two points of tenderness, one at McBurney's point, suggesting appendicitis, the other to the left and a little above the umbilicus opposite the second lumbar vertebra. Sub-

jective pain is usually greater than the localized tenderness, which is the reverse in appendicitis. Nausea is usually present and is not necessarily followed by vomiting, which is less constant. Leucocytosis is usually higher than in appendicitis, and in severe toxemia associated with upper respiratory infection it may mount to 20,000 or 25,000. If associated with influenza, the leucocyte count may be below the normal count. The temperature is usually high and reaches 102° to 103° within a comparatively short time after the onset, which is not the case in appendicitis. Obviously, the greater the general toxemia, the higher the temperature. Children with high temperature frequently have convulsions, whereas adults have chills. The attacks of abdominal pain may come on acutely and abruptly or may recur mildly and become chronic.

If the viscera are congested and there is fluid in the peritoneal cavity, the case may exhibit the picture of peritonitis rather than appendicitis. This is particularly true if one or more nodes break down, suppurate and infect the peritoneal cavity, as happened in 3 of Wilensky's cases.

In one case the abdominal complex resembled appendicitis, although the patient was extremely toxic and acutely ill. In the course of routine examination, I was impressed by the deep injection of the nasopharynx and by a marked congestion of the ear drums. Exploratory laparotomy revealed extensive mesenteric adenitis and generalized peritonitis, the appendix being merely a part of the general inflammatory process. This showed that the child suffered from a peritoneal involvement as a reaction to a systemic infection. The pathology of the ear drum should have served as a warning to the real nature of the case. I have since examined the ear drums in these cases and if deep redness is present, I am inclined to disregard the abdominal complex and treat the case conservatively.

Mesenteric adenitis may resemble and mimic many abdominal conditions in children. The usual diagnostic problem is whether or not the child has appendicitis. Randle Short, of England, states: "In my experience, more mistakes in the diagnosis of acute appendicitis arise from this similarity than from any other cause." The association of the abdominal pain with an upper respiratory infection raises doubt in the mind of clinicians and, occasionally, they may miss an acute appendicitis that happened to be associated with a severe cold. Brenneman cited several cases in which an acute appendicitis was masked by the acute toxemia of an upper respiratory infection and warns the diagnostician by saying: "One must not dwell in a fool's paradise." While the differentiation between appendicitis and mesenteric adenitis has intrigued and baffled the diagnostician, a finer analysis and interpretation of facts may serve to clarify the situation. I shall limit myself to three points in differential diagnosis, which I believe will serve as a guide.

1. Murphy[19] gives the following cardinal symptoms in appendicitis . . . "pain, nausea, and vomiting within a few hours of the time of the onset, localized pain, elevation of temperature. . . . The symptoms occur in the above order, and when that order varies, I always question the diagnosis." In mesenteric adenitis, the order and the sequence of events are apt to be distorted, and, therefore, do not conform to Murphy's clinical rule, as temperature often precedes the abdominal pain.

2. As long as the pathologic process is confined to the walls of the appendix, the patient has no constitutional manifestations, and does not look or feel sick. Taking a streptococcic sore throat as a clinical index of acute illness, no case of appendicitis, in which the pathology is still limited to its walls, ever looks as toxic as a streptococcic sore throat. In mesenteric adenitis, the patient is apt to feel and look ill, which is the greatest single hint that we may be dealing with an acute mesenteric adenitis.

3. The symptoms of appendicitis are usually modest in their expression and pulse, temperature and leucocytosis run parallel to each other. The gradation in quality of these three symptoms is also parallel to the element of time. In mesenteric adenitis, there is no strict parallelism and the time element varies, e.g., a patient may have a high temperature six to eight hours from the onset, with a leucocyte count above 20,000 cells, which rarely occurs in such a short time in appendicitis. With these points as a guiding rule, one may come closer to the diagnosis.

Mesenteric adenitis must be differentiated from other intra- or extra-abdominal conditions. It must be differentiated from intussception, Meckel's diverticulitis, abdominal grippe, pyelitis in the female, and typhoid. Occasionally, pneumonia and pericarditis, refer the pain to the abdomen. Rapid descent of the testicle in male children may give rise to stormy symptoms, referred to the abdomen. I merely mentioned these conditions casually and omitted the detailed differentiation, since appendicitis is the chief concern in most cases.

In the subacute or chronic type, mesenteric adenitis must be differentiated from Moro's "navel colic." The condition was first described by Wertheimer in 1866 who called it "mesenteric neurosis." It was mentioned later by Hutchinson and finally clearly described by Moro[20] in 1913. This condition is characterized by intermittent colicky pain referred to the umbilicus, recurring paroxysmally over a period of many months, especially after eating, when peristalsis is apt to be more active. Children thus affected are of the neuropathic type and in a state of vagotonia. Newman and Cohen[21] explained the abdominal pains on the ground of enterospasms. It is obvious that this picture suggests mesenteric adenitis for which an attempt at differentiation should be made.

There are two other conditions, less known, with which mesenteric adenitis may be confused:

1. Infectious mononucleosis, in which paroxysmal abdominal pain associated with leucocytosis and a predominance of mononuclear cells may be present;

2. Painful fat in McBurney's zone in the Froelich type of children, with paroxysmal abdominal pains.

A subacute or chronic type of intestinal or peritoneal tuberculosis in children may give symptoms which closely resembles mesenteric adenitis, especially if the mesenteric nodes participate in the tuberculous process.

The treatment of mesenteric adenitis depends upon the reasonable certainity of the diagnosis. If one is in doubt at the bedside, and if the patient does not appear acutely ill, one should explore even at the risk of a wrong diagnosis. This attitude must be extended even to the cases which occur in the course of an acute cold, provided the patient does not look acutely ill. One should give appendicitis the benefit of the doubt and explore when reasonable doubt exists. The patient, however, who looks seriously and acutely ill, even though he has an abdominal complex which suggests appendicitis, particularly in the presence of frank nasopharyngeal and ear drum phenomena, is best left alone. The operative trauma and the chemical toxemia of the anesthetic add decidedly to the gravity of the situation and many children thus explored die who, otherwise might have lived.

If we side with Pribram and others who believe that the appendix is the primary cause of adenitis, there is ample justification in doing an appendectomy in the moderately ill patients. Many cases who suffered from vague abdominal symptoms over a period of many months or years and who at operation had extensive mesenteric adenitis with a seemingly normal appendix, recovered and remained well after an appendectomy. If we are inclined to accept the tuberculous origin of mesenteric adenitis, there is justification in the exploration, patients getting well, as do other tuberculous processes following mere exploration. Bell[22] in the summary of his

article says, "All cases of mesenteric lymphadenitis should be treated as tuberculous until proved otherwise."

It is suggested that a reasonably large incision should be made to permit a thorough pathological survey. Pribram and the Mayo's oppose the buttonhole incision on the ground that it prevents a detailed pathological inventory. If the diagnosis can be definitely established, there is no particular risk in waiting. Should there be an element of doubt, early intervention is more desirable. Pribram condemns the tendency to postpone operation for appendicitis after forty-eight hours have elapsed from the time of the onset. While it is true that the acute appendix may recede after that time if left alone, it does not prevent the invasion of the mesenteric lymph nodes which may remain active once established, even after the appendix is removed. Although I am partial to drainage in the presence of pus, I believe that these cases fare better if they are not drained, especially if the process should, after all, be tuberculous, as claimed by some. The question of removal of a node for the purpose of biopsy is by no means settled. Speese[23] cites the case of a patient who died, presumably because of an infection which ensued after the removal of a node. He claims that streptococci may be spread in the peritoneum by such a procedure. Brown[24] shares the view of Speese. I have had no reason to regret the removal of nodes for biopsy. I consider the procedure simple and safe and it can be done without traumatizing the node.

SUMMARY

1. Mesenteric adenitis is, in most cases, a non-specific inflammatory infection of the mesenteric nodes from a nearby or distant focus of infection, occurring most commonly in children during seasonal epidemics of upper respiratory infections, and strongly suggests appendicitis.

2. The symptom complex of mesenteric adenitis is not pathognomonic, yet can be suspected by a thorough analysis and a finer interpretation of the order and quality of symptoms which differ from appendicitis.

3. Exploration is both excusable and indicated when the abdominal pain is associated with mild or no constitutional reaction.

Operation is contraindicated when the patient is acutely ill and the nasopharyngeal mucosa and the ear drums are deeply injected.

Appendectomy either cures or helps in the retrogression of pathologic nodes.

In most cases, the hyperemia induced by exploration exerts a beneficial effect upon the enlarged nodes.

4. Biopsy is always a scientific asset, and there is no contraindication to its performance, except in suppurating nodes.

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TREATMENT OF PRURITUS ANI BY INJECTION*

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IN the practical management of the patient suffering from intractable anal and perianal itching, the primary step is the determination of the cause. Removal of this causative factor in addition to simple hygienic measures may suffice for a cure, unless the itching has been so prolonged that it has become more than a mere symptom. In this event there may persist skin changes such as thickening and increase in the perianal rugae or the presence of skin tabs, and changes in the sensory nerve ends sufficient to continue the itching after removal of the original causal pathology. In such cases the altered skin and the pruritus constitute a disease entity in themselves.

Practical management resolves itself into the following divisions:

1. Diagnosis of the causative lesion or lesions;
2. Local skin treatment, and immediate efforts toward symptomatic relief from itching;
3. Medical or surgical treatment of the causative lesions; and
4. General hygienic measures.

DIAGNOSTIC PROCEDURE

In taking the history, inquiry is made regarding symptoms pointing to the possible presence of allergic diseases, gout, rheumatism, diabetes, or some other general cause of itching, such as jaundice. If indicated, the follow-up is along these lines. Symptoms of other rectal conditions are elicited such as bleeding, protrusion, constipation, diarrhea, pain with or without defecation, and appearance of worms. Finally, the location, duration and variation in severity of the itching, particularly at night, are elicited.

In determining the cause of the itching the following etiological classification is helpful.

Cause of pruritus:

1. Pathology of the anus, rectum, or colon;
2. Constitutional or allergic diseases (including gout, rheumatism, diabetes, food allergy);
3. Portal congestion;
4. Pathology in the pelvic organs with reflex reference of sensation to the anus, or direct perianal irritation by vaginal discharges;
5. Psychic pruritus ani;
6. Idiopathic; and
7. Multiple causes.

When the history and physical findings point to an etiology in the second, third or fourth of the groups, of course the appropriate treatment in these branches is required in addition to treatment locally. A urine analysis, and preferably a blood sugar determination, is always advisable. A diagnosis in the fifth group, psychic pruritus, should be handled with caution lest it later become apparent that this diagnosis was psychic solely with the physician.

Group 6, idiopathic pruritus, indicates that the cause cannot be discovered, or else that it was pre-existent and has been cured, or, perhaps, has spontaneously cured itself, leaving a permanently altered, pathologic, itching skin. It should be borne in mind, too, that pruritus ani may have multiple causes.

By far the greatest number of cases of pruritus ani fall into the first group, and are particularly attributable to pathology in the anus and lower rectum. After the history, to continue the procedure, a thorough routine examination of these regions is made, including external anal and perianal inspection, noting rugae, skin thickening, tabs, skin growths, parasites, and discharge; digital, anoscopic, proctoscopic and sigmoidoscopic examina-

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tion, noting especially the presence of the following conditions, here named in the decreasing order of frequency with which they are found in relationship to pruritus. Only the more frequently recurring conditions, according to the writer's experience, are here mentioned.

1. Proctitis, or coloproctitis;
2. Hemorrhoids (principally skin tabs, thrombotic, prolapsing or ulcerating hemorrhoids);
3. Fistula;
4. Cryptitis and papillitis;
5. Parasites (examine feces for ova if suspected);
6. Healing fissure or granulating surgical wound; and
7. Moist growths, such as condylomata.

Other conditions less commonly found as a cause of pruritus are carcinoma or stricture of the rectum, rectal constipation, or a spastic sphincter. The position of fungus infections, particularly epidermophytosis, in the list is still in doubt, but it should be kept in mind since treatment with simple salicylic acid ointment will be very beneficial. The diagnosis is aided by finding clinical evidences of epidermophytosis of the fingers and by laboratory examination of skin scrapings. This is done either by means of cultures, or by placing the scrapings into several drops of warm, freshly prepared, 10 to 40 per cent aqueous solution of potassium hydroxide on a glass slide. A coverslip is added. After a few minutes to allow the keratin to dissolve, microscopic examination is made for spores and hyphal and mycelian elements.

LOCAL SKIN TREATMENT AND MEASURES FOR IMMEDIATE RELIEF

In a condition as intractable as pruritus ani can be, and as demoralizing and discouraging to the patient, it is necessary to advance the treatment simultaneously in all its aspects to effect a lasting benefit. But particularly to be stressed is the importance of giving some degree of symtomatic relief at once, lest the patient, too early discouraged, fail to continue with treatment. Such relief, at least partial, should be afforded on the occasion of the first diagnostic examination, or as soon thereafter as possible. This will serve also to break the vicious cycle of itching, scratching, excoriation, chronic secondary infection and further itching, and allow the skin an opportunity to heal undisturbed.

The measures advised are cleanliness of the local area, use by the patient of a 50 per cent alcohol wash twice daily and after stool, and application of a mild anesthetic ointment principally for its protective action against rectal secretions and for softening the hardened skin, and also for the possible anesthetic action that may occur on abraded skin or on mucous membrane.

Such measures alone being almost always insufficient to break the vicious cycle, except in the mildest of cases, resort is had to the subcutaneous injection of a solution of an anesthetic in oil to produce anesthesia of long duration. In a series of 30 cases of pruritus ani based on various pathology in which I have employed injections containing nupercaine 0.5 per cent with phenol 1 per cent, and benzyl alcohol 10 per cent in almond oil, 28 had relief varying from a complete cessation to marked improvement of the itching. This relief is still present after six months. Of the remaining 2 patients, one had very slight improvement while in the other a marked neurotic factor was present so that not even the injection of 10 c.c. of novocaine on each of two occasions gave relief, nor did any of the other measures that were tried, including injection of 50 per cent alcohol, excision of skin tabs, and a skin undercutting operation. Minor sloughs occurred in 2 of the patients, but these healed painlessly in a short time with relief of the itching.

It appears that in certain types of patients a tendency to sloughing may exist. Such are the aged, those with very old pruritus, thickened hard perianal skin, diabetics, those with poor circulation and with tissues devitalized by long continued trauma; also of course some luetic patients. However, these are not contraindications. Because of the occurrence of these conditions, at the first treatment I have found

it best to inject in but one location and a small amount, of approximately 2 c.c., so that a slough, if it should occur, will be limited in extent. Later injections may likewise be small if desired, but usually consist of 5 c.c. each, given twice a week.

Technique. The perianal skin is divided into quadrants for the purpose of notation. The skin is well cleansed, an antiseptic applied, and one quadrant is thoroughly injected on each occasion. The needle is inserted into the subcutaneous tissues, not too deeply, but definitely beneath the skin, and avoiding the sphincter ani muscle. This is accomplished easily by palpating the location of the needle point with the free finger. After completion of the four quadrants, the anterior and posterior perianal areas are treated similarly. The needle used is a No. 20 or 21 gauge, two inches long, which is the narrowest gauge to permit the oil to flow properly. Upon conclusion of the course, it may sometimes be necessary to inject a few additional drops, following the patient's directions, into any small areas that have been missed. In some cases, also, itching will persist within the anal canal after the external skin has been relieved. This has been remedied by injecting 1 or 2 c.c. submucously for a short distance, 2 or 3 cm., up along the anal canal through the same external skin punctures, keeping the finger in the anal canal as a guide for the needle point. Neglect of this lower intra-anal area of transitional skin and mucosa may account for failures in completely relieving the itching.

Although sloughing is infrequent, additional precautions will decrease or prevent it entirely, such as warming the oil before use, distributing it evenly a few drops at a time by moving the needle in various directions, then massaging gently with a bit of gauze and advising one or more hot sitz baths when the patient reaches home. The injections must be subcutaneous and made with a dry syringe and needle. Use of a wet syringe is frequently followed by pain. Finally, when an injection is followed on rare occasions by induration, the subsequent injection has been postponed a few days and the induration readily cleared up by hot sitz baths.

TREATMENT OF CAUSATIVE LESIONS

Appropriate medical or surgical treatment is applied to the pathology present, complete discussions of which are to be found elsewhere. For example, coloproctitis is treated by diet and irrigations; skin tabs and thrombotic hemorrhoids by excision under local anesthesia; internal hemorrhoids are excised or injected with sclerosing solutions; and helminths destroyed, according to the circumstances found.

GENERAL HYGIENIC MEASURES

Attention must be paid to these. The correction of constipation by mineral oil, or mild laxatives, diet, fluids, and moderate exercise is important, and this correction alone has on rare occasions relieved the itching. The patient is instructed as to cleanliness of the parts, avoidance of dyed or excessively rough toilet paper and irritating or tight underwear. Overeating, condiments and alcoholic liquors are prohibited; the use of sweets is restricted. Instructions in the rules of general hygiene are appropriate.

It is only by following all four divisions of management with thoroughness and persistence, that relief with any degree of permanence can be assured.

SUMMARY

1. The treatment of pruritus ani requires attention to the factors of diagnosis, local relief, treatment of the cause, and general hygienic measures.

2. The methods of diagnosis of the etiological factors, and their treatment, are described. The pathology is usually located in the anus, rectum or colon; proctitis heads the list of causes.

3. The method of local treatment by injections of anesthetic solutions in oil, the technique of which is presented in detail, has given a large percentage of cures lasting six months or more. Cases of sloughing have been few and can be further diminished by careful injection followed by massage and hot sitz baths.

NOMENCLATURE IN PLASTIC SURGERY*

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FOR the past twenty years, mainly through the efforts of Dr. John Staige Davis, a systematic attempt has been made to separate the branch of plastic surgery from the general surgical tree. The establishment of special surgical services has met with objections in the great majority of surgical clinics because of the natural feeling on the part of the general surgeons that such a division deprives them of opportunities which are legitimately theirs. "At the same time, it is imperative that such services should be established, on account of the best interest of the patient, of medical education, and of those surgeons who are devoting their time and energy to the acquirement of expert skill in special branches of surgery."

Years ago Davis predicted that it was only a matter of time, and that time was rapidly approaching, when there would be created in every large surgical clinic a department of plastic and reconstructive surgery, under men specially fitted and trained for this work. This prophesy has truly come to pass.

In these twenty years, the literature of plastic surgery has rapidly increased and a great number of articles are appearing now in the various medical journals. For this reason, it is essential that a standardized nomenclature be used; and again, mainly through the efforts of Davis, the terminology of plastic surgery has become fairly well established and accepted. In spite of this, many authors are still using such terms as pedicle grafts, when they mean pedicle flaps; and pinch grafts or Reverdin grafts, when they really mean small deep grafts. There is, too, much confusion in some of the literature between large thin grafts (Ollier-Thiersch), whole thickness grafts (Wolfe-Krause), and the thick split grafts of Blair.

GENERAL PLASTIC SURGERY

General plastic surgery is that branch of surgery which deals with the reconstruction of congenital or acquired defects and malformations. It concerns itself with the restoration of function and improvement of appearance. It corrects deformities, treats intractable wounds and large denuded surfaces, requiring skin grafting; but, in the main, limits itself to those lesions which involve the skin and adjacent soft parts.

The term general plastic surgeon is used to distinguish those surgeons who deal with plastic problems of the entire body as outlined, from dentists, maxillofacial, or eye, ear, nose and throat surgeons who have had no previous training in general surgery.

PEDICLE FLAPS

A flap consists of a pedunculated portion of whole thickness skin with more or less subcutaneous tissue, which is attached at some part of its base by a pedicle through which it receives its primary blood supply. This method of skin transplantation by pedicle flaps is an ancient practice well known from earliest times.

The three general methods of using pedicle flaps are as follows:

1. The French method, according to which the flaps are advanced after undercutting the adjacent tissue;

2. The Indian method indicates a procedure in which the flap is obtained from neighboring tissue and implanted into its new bed by rotating the pedicle;

3. The Italian method, in which the flap is obtained and shifted from a distant part of the body. As practiced by Tagliacozzi of Bologna in 1597 for rhinoplasty, a pedicle flap was raised from the left upper arm, delayed for seven to ten days, and

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then the upper pedicle was cut across and the flap sewed into the defect.

The tube flap is an important development in the old Italian pedicle flap principle. The skin is undermined between parallel incisions, rolled into a tube and held by suture of its edges. It is left attached at both ends forming a double pedicle flap. This method of skin transplantation was developed during the World War by Gillies of London and is of inestimable value in plastic surgery. The establishment of the circulation in these tubed pedicle skin flaps was recently investigated in an experimental study by German, Finesilver and Davis.

The transfer of flaps may be *immediate* or *delayed*. The *immediate* transfer of a pedicle flap means that it is implanted into its new bed at once after it is raised. It is, of course, left attached at one end by a pedicle through which it receives its primary blood supply.

The *delayed* transfer of a pedicle flap means that an interval of several days is allowed to elapse before the flap is transferred to its new bed. The main advantage in this procedure is that the circulation of the flap is assured by the delay in its transfer. The best type of flap for the delayed transfer is the double pedicle tube flap of Gillies as described.

Another method of delaying the transfer of a pedicle flap was reported by Blair in 1921. In an extensive experience in making and transplanting pedicle flaps, he concluded that in males regardless of the age, long pedicle flaps can be made with little danger of sloughing; but that in women and children where the circulation is not so vigorous, pedicle flaps are less likely to survive. Therefore, the chance of success

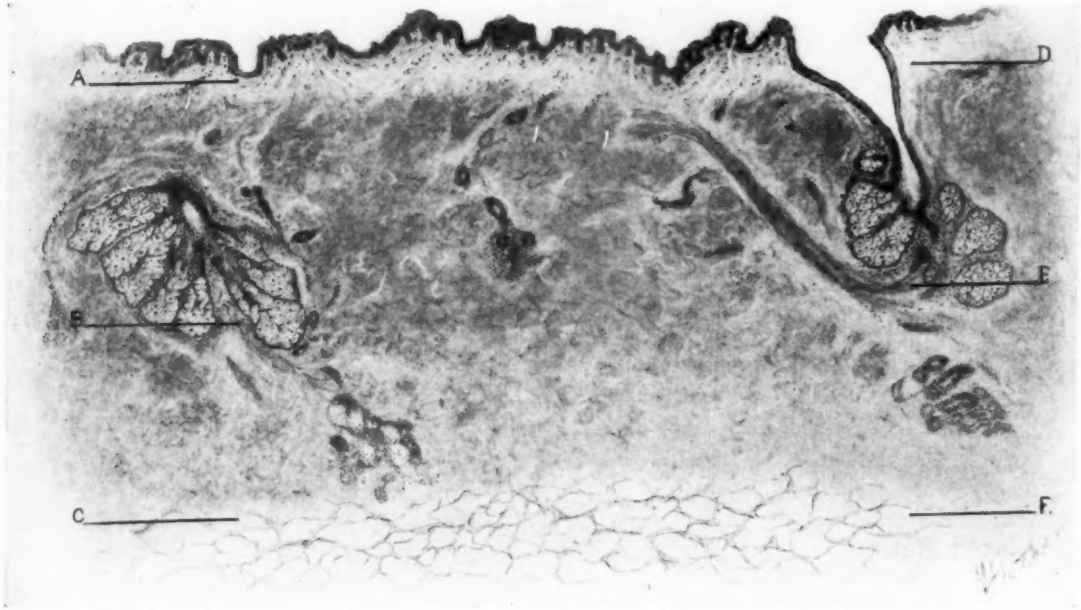

Fig. 1. Drawing of a section of normal skin illustrating the thickness of the various skin grafts.

Large Grafts. A, indicates the thickness of the large, thin Ollier-Thiersch graft which includes the entire epidermis and a thin layer of the corium. B, level of the thick split graft which includes in addition to the epidermis, one-half or more of the corium. Potter, in a series of photomicrographs, demonstrated that the regeneration of the new epidermis in the donor area was from the epithelium of the hair follicles and associated sebaceous glands. C, the whole thickness (Wolfe-Krause) graft includes in addition to the epidermis, the entire thickness of the corium down to the subcutaneous fat.

Small Grafts. D, indicates the thickness of the original small, thin Reverdin graft which includes in addition to the epidermis, a thin layer of the corium. E, the Thick Reverdin graft includes more of the corium than the original Reverdin graft. F, indicates the level of the small deep (Davis) graft which includes the entire epidermis and the whole thickness of the corium down to the subcutaneous fat.

is greater if the cutaneous flap is first raised completely and then immediately sutured back into its original bed and the transfer to the new position delayed for a period of six days to two weeks. At the end of that time, the line of cleavage between the flap and its base is easily developed and the flap is raised. If the flap has a double pedicle, the end which is to be shifted may be divided at one operation, but we prefer gradual division, beginning about the tenth day and after the division is complete, about the fourteenth day, the flap is raised and shifted. By following this procedure, the circulation is assured in long, narrow flaps which otherwise could not survive.

GRAFTS

By the term skin graft, we mean a free transplant of a portion of skin which has been excised and transferred to another part of the body. Its viability depends upon the rapid establishment of a capillary blood supply which is eventually derived from the surface on which it is transplanted.

A. Small Grafts.

1. The Reverdin Graft. In 1869 Reverdin originally described his "greffe épidermique" as purely epidermal in nature. He pointed out later, in 1872, that each one of his grafts included also a thin portion of the corium. The original Reverdin graft is very thin and small, and measures about 0.1 to 0.3 cm. in diameter. It is the thinnest graft that can be cut.

2. The Thick Reverdin Graft. This graft is similar to the Reverdin graft in size and shape, but may be differentiated from the original Reverdin graft by the fact that a thicker portion of the corium is removed with the central part of the graft. It is a graft of intermediate thickness between the original Reverdin graft and the small deep graft.

3. The Small Deep Graft (Davis). This graft was developed at the Union Memorial Hospital in Baltimore by Davis and was first described by him in 1914. It is somewhat larger than the Reverdin graft varying from 0.3 to 0.5 cm. in diameter and is usually round or oval in shape. Davis has repeatedly emphasized this and it is important to note that the small deep graft differs from the Reverdin graft in that the central part of the small deep graft includes in addition to the epidermis, the entire thickness of the corium.

The following comment with reference to this classification is both important and timely. The division of these small grafts into three groups is really academic and for the purpose of correct nomenclature only. Practically, in my opinion at any rate, whenever one of these small grafts is used at present, it is in the great majority of cases the small deep graft of Davis, and not the Reverdin nor thick Reverdin type of graft.

In the literature, the term pinch graft has been commonly and loosely used to designate these small grafts. Pinch graft is neither correct nor descriptive. It is true that at one time, these grafts were obtained by pinching up a bit of the skin into a tented contour with forceps and cutting it off with the scissors. This method has long since been abandoned because of the trauma to the graft, and it follows logically, then, that the term pinch graft should at this time be permanently discarded.

The history of the development of the small deep graft, the technique of cutting and placing this graft, its uses and advantages have been fully explained many times in the numerous publications of Davis.

One of the objections to the use of this graft is the mottled, uneven, and unsightly appearance of the donor area from which the grafts have been obtained. To improve the cosmetic appearance of the donor area, it has been suggested that oval small deep grafts be cut and the individual wounds be sutured. Davis feels that this is unnecessary because usually the healing is prompt and the appearance of the sutured group of oval pits is little better than when suturing is not done. However, another procedure has been developed to improve the appearance of the donor area which seems to be a good solution of this problem. This new method was developed under the guidance of Heuer at the Cincinnati

General Hospital and reported by Goode and later by Conway. It is now being used at the New York Hospital when cutting small deep grafts. The method is described clearly and in detail in an excellent paper by Conway. Briefly, however, it consists in substituting a thin, linear scar for the irregularly mottled and scarred donor area.

B. Large Grafts.

1. The Ollier-Thiersch Graft. Ollier of Lyons in 1872 and later Thiersch of Leipzig in 1886 were the first to describe the use of the large thin graft. The Ollier-Thiersch graft is a large, thin film of skin which includes in addition to the epidermis, a thin portion of the corium. It is, in reality then, a large Reverdin graft and may be compared to it in thickness.

2. The Thick Split Graft (Blair). Blair and Brown originally described this graft in 1929. In general, one-third to three-quarters of the thickness of the corium is included with the epidermis in the thick split graft. It is a large sheet of partial thickness skin and corresponds to the thick Reverdin graft in thickness.

3. The Whole Thickness Graft (Wolfe-Krause). Lawson of London in 1871 was the first to make use of this large free graft. Later in 1875, Wolfe of Glasgow established its use in ophthalmic practice; and to Krause of Altona (1893) is due the credit for the application of the procedure to general surgery. The Wolfe-Krause graft is a large whole thickness skin graft which consists of the epidermis and the entire thickness of the corium down to the subcutaneous tissue. It corresponds in thickness, therefore, to the small deep graft.

The following comments may serve to evaluate in some measure the three large grafts.

A. In the past, because of the comparative simplicity of their application and the certainty of almost 100 per cent takes, the Ollier-Thiersch grafts enjoyed great popularity and were the type most frequently used. They are excellent on fresh granulating surfaces and on freshened scar surfaces that will resist subsequent contraction and on unexposed parts where their appearance does not contraindicate their use. Large defects may be covered in one operation and the donor area will rapidly heal. These large thin grafts are used in epithelial inlays on dental compound molds to line the orbit, mouth, antrum or conjunctival sac. On the other hand, it may be said in fair criticism of the Ollier-Thiersch graft that on bearing surfaces exposed to pressure or friction, it may not give sufficient protection to the underlying tissue. Considerable contraction usually occurs under the graft in the layer of scar tissue which unites the graft to its new bed, and years may pass without the graft becoming loosened from its bed.

B. The ultimate result of a successful whole thickness graft on a freshly made, clean, raw surface is one of maximum mobility, minimum contraction, substantial protection and most natural appearance. The whole thickness graft is especially useful on bearing surfaces where there is constant pressure and friction, as over joints and on the hands. It may be used with even better results than the Ollier-Thiersch graft around molds of dental compound and buried to line cavities, or buried under pedunculated flaps for lining a portion of the flap. Davis and Traut reported a method of obtaining greater relaxation with whole thickness skin grafts which has proved invaluable in such areas as the front of the neck, certain parts of the face, and also in the correction of webbed fingers and the release of axillary adhesions.

But considerable time, skill and meticulous attention to details are necessary to obtain a successful whole thickness or Wolfe-Krause graft. This type of graft must be carefully removed by sharp scalpel dissection; it must be secured in its new position with tension equal to that of normal skin; and attention must be paid to the problem of the right amount of pressure to be applied to the graft. It cannot be used on the common granulating wounds because the base upon which the graft is placed must be free from infection. An additional problem is that the wound produced by the removal of the whole

thickness skin graft must subsequently be closed.

C. From our own experience with the thick split graft, we agree fully with the observations made by Potter in an excellent recent paper, that this type of graft appears to have most of the advantages of both the Ollier-Thiersch and whole thickness grafts with none of the disadvantages. By the use of a suction retractor and special knife as described by Blair, the thick split graft may be cut as readily and as simply as the thin Ollier-Thiersch graft but with a much greater certainty of the take as compared to the whole thickness graft. A large thick split graft can readily be obtained with little damage to the donor area from which it is obtained, and, if properly used, gives good protection and good final appearance. Spontaneous healing of the donor area readily takes place in about ten days. In the great majority of our cases, therefore, we are now using the thick split graft, reserving the Ollier-Thiersch and whole thickness grafts where specifically indicated.

CLASSIFICATION OF GRAFTS

	Small	Large
Thin	Reverdin graft	Ollier-Thiersch
Intermediate	Thick Reverdin	Thick split graft
Thick	Small deep graft	Whole thickness (Wolfe-Krause)

SUMMARY

The literature of plastic surgery is rapidly growing, therefore, a standardized nomenclature which has now become fairly well established, is described. Skin grafts and flaps are classified and defined. At the same time, an attempt has been made to evaluate the more important procedures in plastic surgery.

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THERAPEUTICS OF MAGGOT ACTIVE PRINCIPLE

CLINICAL APPLICATION IN 1020 CASES

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HISTORICAL

DURING the past six years a growing interest has been shown in maggot therapy as evidenced by the rapidly increasing literature. In reviewing these references it appears that opinions differ regarding the therapeutic effectiveness of maggots. Many mentions have been made of an active therapeutic agent which in itself is healing and which may be substituted for the living scavengers.

Hammett and Reimann, and Kendall have reported favorably on the sulphydryl $(S.H.)^-$ group as a growth stimulating agent.[1–4] Brunsting and Simonsen[7] have confirmed the work of Hammett, Reimann and Kendall and have satisfactorily stimulated granulation in cutaneous ulcers by means of the sulphydryl containing the amino-acid cysteine. Stewart[8] believes the therapeutic benefit derived from maggots is due to the high calcium content which in the presence of picric acid forms the insoluble calcium picrate which is chemically an active healing agent. Robinson[9] believes that the presence of allantoin is the therapeutic agent responsible for healing in maggot therapy.

In 1932 Livingston and Prince[5,6] reported their results in 200 cases of chronic osteomyelitis treated by a saline extraction of whole maggots. In this series 88 per cent were clinically improved; the remaining 12 per cent failed to respond because of the severity of the lesions, although at that time it was not known by what mechanism these clinical results were obtained. In 1936 the results in the treatment of 567 cases of chronic metastatic and traumatic pyogenic osteomyelitis by maggot therapy were reported.[10] The high percentage of satisfactory results has been substantially maintained over a period of six years with the use of maggot extract. During this period 1020 cases of chronic suppuration have been treated as shown in the accompanying table.

In summarizing the table, 415 cases have been treated by living maggots and maggot active principle in combination, and 605 cases have been treated by maggot extract alone. In this series living maggots have been used only in large suppurative, copiously discharging wounds because of the mechanical difficulty of introducing a fluid into such a wound. When the exudate decreased, maggot active principle was substituted for the living larvae and used either as a Murphy drip or a wet pack.

RESULTS

Throughout this study the comparative results of sulphydryl $(S.H.)^-$, allantoin, calcium picrate, and cysteine were tabulated. The claims of the various authors were confirmed. The conclusions based on the chemical analysis and clinical trial are:

1. Maggot extract contained all of the above radicals, viz., sulphydryl $(S.H.)^-$, natural allantoin, calcium, cysteine, glutathione, and in addition embryonic growth stimulating substances.

2. Maggot extract is therefore a powerful growth stimulant as is evidenced by the claims for each of its growth stimulating ingredients.

3. From 60 per cent to 100 per cent of the cases treated showed clinical improvement through growth stimulation and a pathogenic bacterial inhibition.

4. The former belief that the effectiveness of maggots is due to their mechanical action has been replaced by the present concept, based on clinical evidence, that the stimulation of tissue regeneration is due to the substances mentioned.

Types of Infection	Region	No. Cases	Live Maggots and Active Principle	Active Principle Only	Results
Chronic metastatic osteomyelitis.	All bones	567	400	167	88 per cent healed; 12 per cent failed to respond or recurred.
Chronic osteomyelitis following injury or compound fractures.	Long bones, skull, small bones of hand and feet	266	10	256	60 per cent healed; 40 per cent resulted in amputation because of large involucrum incorporating many pockets of infection and the large number of fractures in the lower third of the tibia.
Acute metastatic osteomyelitis.	Clavicle, scapula, femur, tibia	6	0	6	100 per cent healed; these cases were all treated early.
Acute osteomyelitis following injury, gun shot wounds, or recent fracture.	Long bones, clavicle, small bones hands and feet, spine	12	0	12	84 per cent healed. Two cases of compound fracture of the clavicle did not respond.
Burns, 1°, 2°, 3° including chemicals, radium and x-ray, with secondary infection.	Extremities, body and face	24	0	24	100 per cent healed. All areas covered with pink healthy granulation tissue and epithelialized without the usual contractures in the scar tissue.
Cystitis, due to Bacillus coli and staphylococcus.	Genitourinary tract	7	0	7	71 per cent improved. These cases were of long standing with a history of repeated hospitalization and treatment by various antiseptics. Five of these cases showed a negative culture after irrigation with maggot extract, for the first time in several years.
Pyelitis—due to B. coli or staphylococcus.	Genitourinary tract	5	0	5	60 per cent improved. Same as in cystitis. The maggot active principle was introduced into the pelvis of the kidney at time of cystoscopy.
Endocervicitis.....	Cervix	1	0	1	The vagina was packed daily with a tampon for six weeks saturated with maggot extract. Later irrigation of the vagina was done daily for six weeks. Relief from the leucorrhea was permanent.
Chronic indolent ulcers, all types.	Leg and foot	100	4	96	82 per cent improved. Living maggots were used in 4 cases to cleanse mechanically foul, necrotic areas. After several applications maggot extract was used. In 96 cases the extract only was used. When necessary the circulation was supported by a Boehler's Boot.
Infections due to gas bacillus.	Upper extremities	1	1	0	Following multiple large incisions, a large number of maggots were allowed to cover the hand and forearm. The patient died in five days.
Sloughing necrotic areas following burns, or in malignant lesions of the skin.	Rectum, perineum, face, skin	5	0	5	100 per cent improved. In malignant lesions of the skin the extract helps to eliminate the odor due to secondary infection, because of its growth stimulating property. Following burns pink healthy granulation is stimulated.
Small discharging sinuses due to staphylococcus infection.	Extremities	10	0	10	100 per cent unimproved. In small discharging sinuses with underlying infection maggot extract was used unsatisfactorily. In tuberculous sinuses it is also of little value.
Postoperative non-healing wounds.	Abdomen, shoulder	3	0	3	100 per cent recovered. In 3 cases of postoperative suppuration in abdominal incisions with gapping wounds, maggot extract was used satisfactorily as a growth stimulator. All 3 wounds healed without herniation.
Middle ear disease..	.....	3	0	3	100 per cent recovered. Maggot extract in a 50 per cent alcoholic solution as a vehicle was used as an irrigating fluid in 3 cases of suppurating middle ear disease of long standing, with recovery.
Skin grafts.....	Extremities	10	0	10	100 per cent took. Ten cases of pinch skin grafts were treated by covering the graft with an Argyle membrane and a sea sponge over the membrane under moderate pressure. The sea sponge was kept moist constantly with maggot active principle. The dressing was not disturbed for ten days. In 5 other cases used as controls which were otherwise treated, 3 took and 2 failed to respond.
Total.....	.....	...	415	605	

APPEARANCE OF HEALING WOUND

The wounds when stimulated by maggot active principle following a debridement or a radical sequestrectomy, quickly filled with pink healthy granulation tissue; granulations sprung from the depths of the medullary cavity and from the walls of the wound completely filling the cavities to the level of the skin. Epithelization completed the process without a depressed scar. The period of healing was from six to twenty weeks.

ADVANTAGES OF MAGGOT EXTRACT

1. The extract is stable at room temperature and when tested after six months on the shelf was found to be still active.

2. The psychic trauma of living maggots is eliminated.

3. It is a more powerful growth stimulant than any one of its ingredients, which were used alone as a control.

4. The extract has a wider applicability than living maggots.

LIMITATIONS

Maggot extract was successful in only 5 per cent of the cases of tuberculous origin; 12 per cent of the cases of chronic pyogenic osteomyelitis having a large involucrum incorporating multiple foci of infection, or chronic pyogenic osteomyelitis undergoing molecular necrosis, or cases having positive blood cultures, failed to respond satisfactorily.

SUMMARY

1. Maggot extract is a growth stimulating substance substantiated by the claims for each of its growth stimulating ingredients.

2. The therapeutic action of maggot extract has been proved by clinical trial in 1020 cases of acute and chronic suppurative lesions.

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CASE REPORTS

SUPRARENAL TUMORS

A REPORT OF TWO CASES

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MY object in presenting these two cases is two-fold: (1) to show how the ordinary routine methods employed in urology may be inadequate in the diagnosis of suprarenal tumors and (2) to call attention to a most unusual type of tumor as exhibited by the second case. My remarks apply chiefly to subdiaphragmatic tumors which are too small and too far under the diaphragm to be detected by palpation. They apply also to the non-cortical type of tumor, for tumors arising from the adrenal cortex not infrequently produce sex changes which may lead to a suspicion, at least, of the presence of tumor. They further apply to tumors which may be located similarly to adrenal tumors but which do not arise from the adrenal gland, i.e., to be more specific, non-adrenal tumors which may be found between the upper pole of the kidney and the diaphragm.

CASE 1. A fifty-four year old Pole was admitted to one of the Bellevue Surgical Services, April 6, 1935, complaining of pain in the back, particularly on the left side. Three months before entering the hospital, the patient experienced sharp, knife-like pain in the left costovertebral angle, radiating across the abdomen beyond the umbilicus, accompanied by nausea, cold sweats and faintness. For the next two and a half months there were several such attacks which lasted from a few minutes to an hour or so and were followed by a feeling of soreness in the abdomen. There was no history of hematuria.

After various gall-bladder examinations and gastrointestinal *x*-ray studies were made, the patient was transferred to the Urological Service, where the usual routine urological examinations were done. Separate kidney functional tests indicated excellent and seemingly equal functioning capacity of both kidneys. According to the retrograde and intravenous urograms there was no indication of stones or any abnormality of the upper urinary tract, except that in one of the films there was an indefinite shadow about 4 cm. in diameter just above the left kidney shadow. Several urinanalyses were negative. The blood chemistry was within normal limits, the blood pressure varied from 114/70 to 150/90 and the temperature was never above 100. prior to his operation.

So little in the way of positive findings had been gleaned from the various urological examinations, that we were on the point of sending the patient back to the surgical service with a negative urological report. The indefinite shadow above the left kidney was the only thing in the nature of a helpful positive finding and even that was not at all convincing. Besides, the patient did not appear to be ill and no one had seen him in pain. But still the patient insisted, as well as he was able, for he spoke almost no English, that he *bad bad* severe pain in the left loin and was still tender there at times. Finally an interpreter obtained the first, real definite statements of the patient's complaints. They corresponded in the main with the information previously obtained but emphasized the severity of the loin and abdominal pains. The interpreter also convinced us that there was tenderness, though slight, on bimanual palpation of the left loin at the costovertebral angle. Therefore because of the loin tenderness and the indefinite shadow, it was decided that an exploratory operation on the left kidney should be done.

* Read before the April, 1936, meeting of the Section of Genito-Urinary Surgery of the New York Academy of Medicine.

The usual oblique kidney incision was made and to our surprise, a tumor about the size of a tennis ball was found attached to the upper pole of the left kidney. It appeared to be part of the kidney itself but closer inspection showed that the mass was bound to the kidney by adhesions only and was easily separated from it. It was thought at the time to be a tumor of the adrenal gland, because the gland could not be found in its usual location after the mass was removed.

Fig. 1a. Case 1. Retrograde pyelogram, both kidney pelves appearing to be quite normal. The "indefinite shadow" above the left kidney is too indistinct in the photograph to be seen.

Except for the fact that there was some postoperative oozing from the tumor bed, which was controlled by packing, his postoperative recovery was uneventful. The patient was seen about two months after he left the hospital and appeared to be slowly losing ground. He has not been seen or heard of since.

The pathologist's description of the tumor is as follows:

"Macroscopic: Specimen consists of a large tumor mass measuring 0.8 × 0.8 × 0.4 cms. and appears to be fairly well encapsulated. The suprarenal gland is present at one pole and on cut section this tumor mass is found to be surrounded by a fine layer of yellow suprarenal tissue. The tumor itself is firm, white and very friable.

"Microscopic: Section shows a fairly well circumscribed tumor growth. Around the edge of this tumor growth, there is a border of varying thickness of adrenal cortex. These cells also extend in some areas down into the tumor itself along fibrous tissue septa. The tumor itself is made up of large oval or polyhedral cells with an eosinophilic cystoplasm and large round or oval nuclei. Mytotic figures are present. The tumor cells are arranged in nests which appear to be made up of multiple coils, and sometimes form glands. In areas these cells have a rather clear cystoplasm. In other areas the tumor is largely necrotic. It is supported by a rather dense, fibrous stroma.

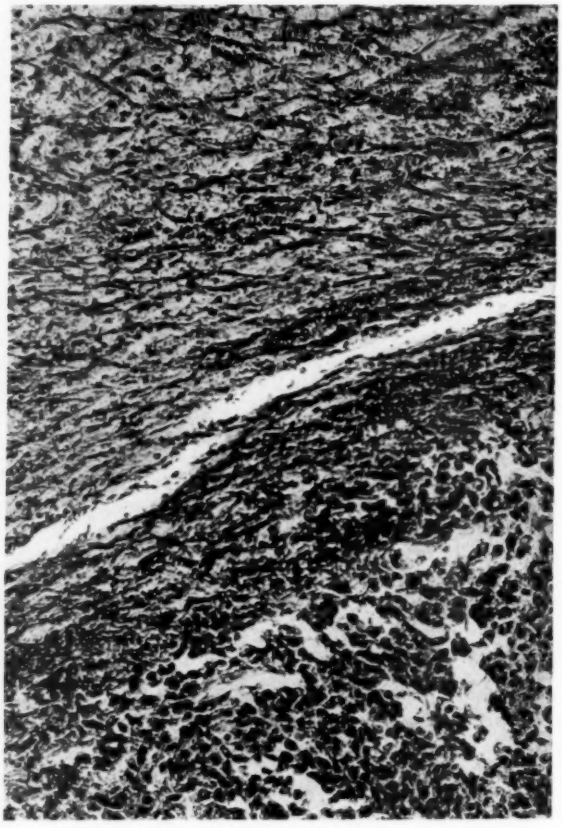

Fig. 1b. Photomicrograph of tumor which was attached to upper pole of kidney; note the invading tumor cells in the lower right hand corner.

"Diagnosis: Metastatic adenocarcinoma of unknown origin."

Case II. This patient was a married woman, forty-two years of age and the mother of one child. She was referred November 8, 1935, because several months before she had

been told that she had a kink of her right ureter. The patient's complaints at the time were most indefinite, but stated there was pain

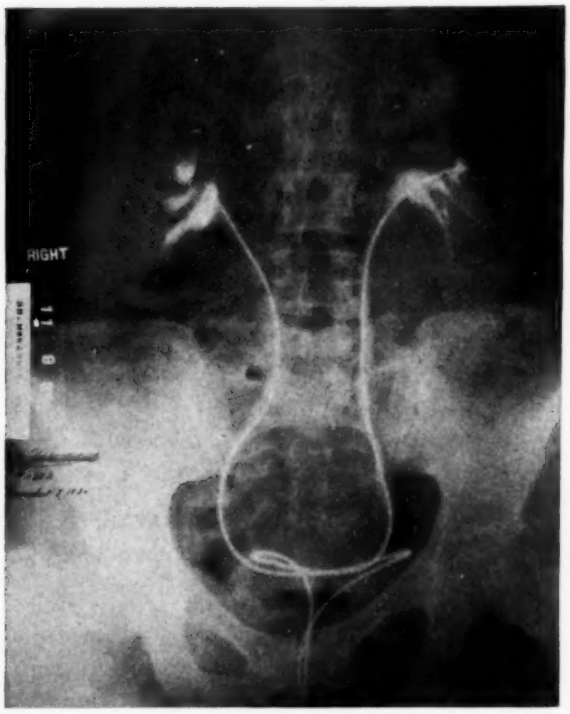

Fig. 2a. Case 11. Retrograde pyelogram shows that both kidneys are low and the left one is definitely rotated.

in the epigastrium, radiating toward her right lower quadrant and vice versa and were closely related with severe headaches from which she suffered very frequently. She also had marked night sweats. There were no urinary symptoms and close questioning did not reveal a history of pain in either costovertebral angle. She had lost about twenty-five pounds in weight in a comparatively short time.

The physical examination revealed only the fact that the lower pole of her right kidney could be quite easily palpated when she inspired deeply.

There were a few white blood cells in her bladder urine which was otherwise negative. In the catheterized urine specimen from her right kidney were a few white blood cells while the left kidney specimen was negative. According to the indigocarmine test, both kidneys functioned well. The urograms showed both kidneys to be quite low with fairly marked rotation of the left kidney, especially in its short axis. No stricture of either ureter was evident.

About seven weeks later the patient suddenly went into a collapse with rapid pulse and cold sweats, soon followed by a rise in temperature

Fig. 2b. photomicrograph of tumor found at autopsy.

to 105°. Her physician saw her and within two days she was much improved with a temperature of 101. a regular pulse of 120 and of good quality. On the fourth day she suffered another collapse similar to the first and died within two hours.

A partial autopsy was obtained and a tumor, also about the size of a tennis ball was found above the left kidney. I am told by Dr. N. C. Foot of the New York Hospital, who examined this tumor histologically that it is exceedingly rare. On that account, I shall present in detail his report which he has kindly furnished together with other points of interest concerning adrenal tumors.

"Microscopically this tumor is found to consist of nests of cells which, when properly impregnated with silver, have all the characteristics of more or less mature astrocytes, but as mitotic figures are found, this apparent maturity may be questioned and the tumor considered as definitely malignant.

"Tumors originating in the suprarenal are comparatively unknown. For instance, simple adenomas of the organ have been found in about 3 of 1500 autopsies. Malignant tumors are somewhat more numerously reported, but even so may be considered to be a rarity. As to the significance of this particular growth, the following may be said: Tumors of the adrenal cortex do not concern us here; these are the hypernephromas and the renal carcinomas. The tumors of the adrenal medulla arise usually from one or another of the nervous elements constituting that portion of the gland. Thus we may have the sympathicoblastoma with its various ramifications arising from varied elements of the sympathetic-ganglion complex. The tumor under discussion might be considered as representing a step in the development from a ganglionic crest cell to the more differentiated ganglion cell or capsule cell. In this case, however, the line of differentiation has followed that seen in the brain rather than that seen in the suprarenal gland. I have never seen a report of a similar tumor, although I believe that many may have been overlooked, owing to the failure of the examining pathologist to use silver impregnations. The only other tumor of the adrenal medulla that should be mentioned in this connection is the paraganglioma arising from the chromaffin cells. This is by far the most common of the adrenal medullary tumors and although it somewhat resembles the growth under discussion, it is composed entirely of large, irregular cells which contain pigment and show an affinity for silver which takes the form of small, black granules in the cells. Such granules do not appear in our tumor.

"The diagnosis in this case is glioblastoma of the suprarenal medulla and is based on the fact that the cells are brought out most sharply and distinctly by impregnations which have been devised to show glial cells rather than neurocytes."

CONCLUSIONS

To return to the first reason for presenting these cases, I merely wish to emphasize the point which these two patients well illustrate, namely, the fact that our ordinary urological methods of diagnosis sometimes do not help us at all where there are small adrenal tumors. The fact that the kidney is rotated and is low is a suggestion, it is true. But we often see pyelograms indicating rotated low kidneys where there is no pathological condition adjacent to the kidney to account for its position and rotation. The tumor may throw a shadow by means of the ordinary flat film which will be suggestive, but oftener than not such a shadow is obscured by gas. The point I wish to make is that when there is the slightest suspicion that there may be a tumor above the kidney and underneath the diaphragm, air injection, followed by *x*-ray picture, as suggested by Carelli[1] a number of years ago and now employed by Cahill, should be done.

My second reason is to call attention to the lack of definite symptoms indicating a tumor of the adrenal medulla. Whatever other symptoms this patient may have had, she did not complain once of pain in her left loin. At best, any pain which by any stretch of the imagination might have been associated with her kidneys or adjacent organs was on her right side in the lower quadrant. Her tumor was found above the left kidney.

In the second case, the high temperature during the last few days of the patient's life is interesting. Israeal, quoted by Lazarus and Eisenberg[2] in their report of 2 cases of paraganglioma, stated that fever was present in 57 per cent of the reported cases of tumor of the adrenal gland. Whether or not in my second case this was purely a terminal type of temperature or was merely a terminal manifestation of a totally unrelated condition, we cannot say.

1. Carelli. Personal demonstration.
2. Lazarus and Eisenberg. Tumors of the adrenal gland: report of two cases of paraganglioma of the adrenal gland. *Jour. Urol.*, 27: 1, 1932.

SUMMARY

Two cases of suprarenal tumor are presented: one a metastatic adenocarcinoma involving the suprarenal gland and the other aglioblastoma of the suprarenal medulla, a very rare tumor.

In the first case the tumor was suspected and confirmed by exploratory operation. In the second case the diagnosis was made only after an autopsy had been performed.

For the diagnosis of suprarenal tumor, it is pointed out that the usual urologic diagnostic methods are generally inadequate, but that *x*-ray studies preceded by the injection of air about the adrenals are of definite help.

DISCUSSION

DR. EDWARD HALL KLINE (by invitation). A few more of the clinical details of the second patient who, unfortunately, died, would be interesting. She was sent to be cystoscoped because of her pain, which was supposedly due to a kinked ureter, as had been previously diagnosed. She was doing exercises because she thought perhaps she had a dropped kidney. The cystoscopic examination seemed to show both kidneys were down a little. On the morning of January 6 she went into complete collapse, practically surgical shock, her blood pressure was in the neighborhood of 60 systolic, and her pulse could not be counted. Her heart was still beating and her extremities were icy cold but were not cyanotic. She was vomiting, which could not be stopped by any of the usual methods. She complained of a terrific headache, which persisted. By eight o'clock that night she had a temperature of 105. Her pulse had begun to feel more like a pulse and could be counted. She went through the night and her temperature came down to 101., her pulse became stronger and of a better volume, ranging between 120 and 140. She had no headache all day but the extremities were still cold. There was no abdominal pain except as the result of vomiting. Her kidneys were not tender and she complained of no pain in the kidney region. By the night of January 8 her temperature had gone back to 103, the pulse rate remained the same, and she slept all night. On the early morning of January 9, she went into a second collapse with a temperature of 106., and the coldness of the extremities more exaggerated than before. Her pulse was imperceptible, the rate could not be counted, and within two hours she died. Up to the last minute she remained conscious, still complaining of terrific headache. A postmortem laparotomy showed a tumor the size of a tennis ball, and when we cut into it there was blood clot in this tumor. Apparently she had had a large hemorrhage into it. The tumor was of firm consistency, and the microscopic slides proved its neurological origin. It gave the appearance of a hypernephroma on gross inspection. Altogether it was a very unusual case pathologically, but very tragic for the patient.

DR. GEORGE CAHILL. In the first case reported by Dr. Jeck, he reported a metastatic carcinoma involving the adrenal, and most of us are perhaps unaware of the frequency of metastases in the adrenal. Burke, from the New York State Institute for the Study of Malignant Disease, reported that in 400 cases of metastatic malignancy dying in the Institute and on which they had complete autopsies, the adrenal was involved almost forty times. He included in his 40 cases only 2 in which the adrenal was primarily malignant. In other words, the adrenal is involved in a carcinoma elsewhere much more frequently than we anticipate. That has been particularly brought to our attention in a case that was admitted to the hospital, a telephone lineman, who entered in the middle of the summer, quite deeply tanned on his hands and face, with marked hematuria, and an extreme degree of anemia from bleeding. His anemia was cured by transfusions. Cystoscopy revealed that his bleeding was from the left kidney. The pyelogram showed that he had a malignant tumor of the left kidney. Operation was performed on his malignant left kidney with complete removal of the kidney, perirenal fat and adrenal on that side, the tumor having broken through the capsule in several places, so that these structures were removed en masse. Following the operation the patient was fairly well for twenty-four hours, and at the end of thirty hours he suddenly went into extreme collapse; his blood pressure dropped to 40 or 50; he had tremendously high temperature and showed all the symptoms of complete adrenal failure. He died in spite of transfusion and the injection of the only prepared cortical extract we had. Autopsy disclosed the only metastasis which he had from the tumor in his left kidney was in the right adrenal, which was completely destroyed. In other words, this man had Addison's disease to a certain degree. He had some pigmentation but was so brown that we assumed it to be purely sunburn from exposure.

As far as the second case is concerned, medullary tumors of the adrenal are not common in

adults; they are seen mostly in children. They were described a long time ago in children by Pepper and Hutchinson. These tumors arise from the sympathetic nervous system, which forms the medullary portion of the adrenal and give rise to various symptoms, although some remain symptomless. Those that do not give rise to symptoms in children have been frequently distinguished by the size of the tumor, leading in itself to diagnosis. Second, they give rise to metastases; the Pepper tumors frequently to the liver, and the Hutchinson tumors to the rib or skull or neck. They are the same tumor in all respects, except that they metastasize by a different route. Tumors of the medulla have been reported, which give rise to paroxysmal hypertension, sometimes associated with pulmonary edema and death occurs immediately after the attack. Removal of the tumor, or removal of the adrenal with the tumor, in reported cases has produced absolute cures.

The occurrence of a tumor such as Dr. Jeck has reported in an adult must be very rare, although when searching the literature it will be found that every possible type of tumor has been reported as occurring in the adrenal. When a tumor occurs and it is harmless, we are apt to miss it. When we see a kidney which is misplaced and there is no explanation for this, we are justified in trying to develop something outside the kidney as the cause. In our hands the development of shadows outside the kidney has been best done by the introduction of air after the manner of Carelli, disclosing many things by injection which would otherwise have passed unnoticed. Not only do we introduce air on the side on which we suspect an extrarenal shadow, particularly an adrenal shadow, but we introduce air on the opposite side, because autopsies have shown from 15 to 20 per cent of inadequately functioning adrenals on the opposite side. Therefore it is absolutely essential in these cases to determine if there is an adrenal on the other side. This is brought out particularly by those men who have done adrenal surgery, for they prefer to use the transperitoneal approach as it gives them an opportunity to supplement the air injection, if used, showing the adrenal, with palpation of the adrenal on the opposite side. Palpation of the opposite adrenal is sometimes very deceptive in a fat person. However, it has been shown fairly definitely in so far as we have done this work, that when a tumor is present, we usually have been able to demonstrate it, practically in every case, the air injection clearly bringing out the tumor.

It would be interesting to learn whether an adrenal was present on the opposite side. This knowledge would be essential, for tumors of the adrenal are prone to hemorrhage, and in the literature there are cases of solitary adrenals in which there was a tumor that had hemorrhaged, and the patient died with all the symptoms of acute adrenal failure. Certainly the description which Dr. Kline gave is the classical one of acute adrenal failure. I have taken out an adrenal tumor which did not have sufficient adrenal on the opposite side to keep the patient alive, and Dr. Kline's description of a high temperature, pulse going to nothing, collapse and death, in spite of large quantities of cortine and transfusions, coincides with the picture in this case I mention. The same symptoms of tremendous emaciation, very high temperature and dehydration, sometimes with convulsions, have occurred with evidence of sepsis in necrosis of adrenal tumors, in cases with solitary adrenals.

DR. STANLEY R. WOODRUFF. We have had one case of tumor of the suprarenal gland but it was a primary tumor in an infant, and I understand most of the primary tumors of the adrenal are in infants. This child had a large mass in the abdomen; cystoscopic examination showed the kidney displaced almost down into the true pelvis, and a practically normal renal pelvis in the kidney itself, with this mass above it. We suspected a tumor of the adrenal, but it was so large that removal was impossible. Autopsy two months later showed a very large neuroblastoma of the adrenal attached to the kidney, the kidney itself being practically normal.

PROLAPSE OF FEMALE URETHRA WITH GANGRENE*

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PROLAPSE of the female urethra consists of the protrusion through the meatal orifice of the urethral mucous membrane, in association with some submucosal and fibromuscular elements. This comparatively rare lesion, which is analogous to rectal prolapse, presents some interesting etiological and clinical problems. However, its therapy still remains a moot question.

We have been prompted to present this communication in the hope of stimulating an interest to the ultimate clarification of the problem, because this pathologic phenomenon has been largely ignored owing to the difficulty of its management in a large percentage of cases and the occurrence of a definite mortality rate.

Several authors have published very thorough studies on this subject, notably Kleinwächter, Pinkus and Säuferlin. The latter, in 1929, fully examined the literature and descants at great length on every phase of the question. The first recorded reference is that by Solingen in 1732. From 1732 to 1926 inclusive, Säuferlin collected 270 reported cases. There has been reported 29 additional cases not noted by Säuferlin, which with the one herein described, makes a total of 300.†

To a summation of the recent literature, we add the history and course of a personal case.

Mrs. J. M., sixty years of age, came to the Urological Department of Mt. Zion Hospital on December 4, 1935, complaining of difficulty in urination of four days duration, blood in the urine and pain about the vulva when sitting.

She was the mother of a grown son, had never been operated upon, had had the menopause fifteen years prior to admission and in 1921 had cystitis which cleared promptly with bladder irrigations.

Present Illness. Four days previously after a "very hard day's work" she noticed the sudden onset of symptoms. There was difficulty in urinating so that only a few drops were passed at a time, at frequent intervals of one-half to one hour, day and night. Then she noted a "lump sticking out of the bladder" which was painful on sitting. There was blood in the urine and on her clothes. After a few days she was conscious of a very foul odor from the vulva. Associated with these symptoms was a general weakness which prevented the performance of her regular duties as housekeeper.

Physical Examination. Local examination revealed a second degree cystocele and the presence of an extra-meatal protrusion of the urethra in the form of a mushroom shaped mass roughly 3 cm. in length, the entire surface of which was covered with a black gangrenous slough (Fig. 1). The odor was very offensive. Attempt at reposition was completely unavailing. No special sensitivity to touch of the extruded membrane was evident. A soft rubber catheter could be readily passed through the center of the mass into the bladder, where but a few drops of urine were obtained. A diagnosis of prolapse of the urethral mucous membrane with gangrene was made and the patient hospitalized.

Treatment. Hot compresses were applied locally for twenty-four hours while physical and laboratory studies were undertaken. The general findings were relatively negative.

On the following day, under general anesthesia, the frankly gangrenous tissues were amputated, the edges being trimmed down to healthy tissue. An 18 F. mushroom catheter

† These additional cases are reported by: André, Gomperts, Keefe, Loux, Ormond, Parzani, Pinevich, Pollak and Klement, Retzlaff, Reynard and Sassard, Sorrentino, Tagliaferro, Thévenot, and Thurn-Rumbach, 1 case each; Livermore 2 cases; Hepburn 3 cases; Murray 4 cases; and Säuferlin 6 cases not included in his total.

* From the Department of Urology, Mt. Zion Hospital, San Francisco.

was inserted into the bladder and fixed with a silkworm suture passed through the catheter and both urethral walls. The suture sloughed away in two days. However, the catheter remained in the bladder and functioned very well. It was removed on the seventh day and the patient was able to urinate quite normally thereafter. Her general condition improved greatly with bedrest and she was discharged on the twelfth day. She has since returned to work and has been well for the past six months except for occasional incontinence (Fig. 2).

Postoperative Findings. Cystoscopic examination was performed subsequent to her discharge. The bladder capacity was 150 c.c. and was cleaned readily. The mucous membrane was clear with coarse trabeculations in the dome of the bladder. The trigone very irregular, being thrown up into many longitudinal folds and markedly hypertrophied. The right meatus was triangular and appeared to be under tension anteriorly; the left meatus was normal. No tumors, ulcers or foreign bodies were seen. The sphincter was relaxed and smooth, but no polypi were seen. The entire urethra was highly congested.

ETIOLOGY

The etiological factors are not particularly clear and opinions on this point differ, however, certain facts are prominent. One is that of the age of incidence, which varies from the youngest of five days to the oldest of ninety-two years. Säuferlin, in an analysis of 211 cases, found 105 cases in children, an incidence of 49.7 per cent; 41 cases or 19.4 per cent in sexually mature women; and 65 cases or 30.8 per cent in women over forty-five years.

In our analysis of 235 cases* we found a definitely greater incidence in the postmenopausal group. There were 111 cases or 47.2 per cent in children; 42 or 17.8 per cent in sexually mature women; and 82 cases or 34.9 per cent in women over forty-five years. The greatest incidence we find occurs in the age groups between eight and twelve years and sixty and sixty-five years. The reasons for this are believed to be the following: In children, the elongated, perpendicularly placed urethra lies in a bed of soft, loose tissues which gives it great mobility. There also seems to be a relatively stronger development of mucous membrane than muscularis. In addition, there is a funnel shape to the urethra in its transition from the bladder to the meatal orifice. These factors give rise to looseness of the mucous membrane, which under stress can be extruded through the urethral orifice. In the postmenopausal woman the shrinkage incident to senile atrophy and involution in the circumurethral structures tends to lift the mucous membrane from its bed, and under stress to cause its possible extrusion. The trauma incident to childbirth would seem to be such a factor for causing the prolapse, but a large percentage of cases occur in children and some in nulliparous women (Keefe). In this connection, Pinevich cites a striking case of a woman of twenty-eight years, who after a prolonged difficult labor with forceps delivery, developed a urethral prolapse with complete closure of the orifice, followed by a vesicovaginal fistula. Drainage was effected by the retrograde passage of a catheter through a bladder incision. The fistula closed spontaneously and the prolapsed tissue was subsequently amputated.

Other predisposing causes may be considered, namely, (1) congenital defects which includes tissue weakness and an abnormal width to the urethra; and (2) acquired, which includes inflammations, foreign bodies, neoplasms of the urethra and bladder and debility from chronic ailments. Contributory elements are trauma, such as improper instrumental manipulation, rape, violent coitus per urethram of which 4 cases were reported. All forms of strain or increased intra-abdominal pressure are provocative of a procidentia in the presence of anatomical predisposition. This may include obstipation, diarrhea, tenesmus, great physical effort, prolonged second stage of labor and violent coughing. Keefe believes the etiology is neuromuscular due to a predominant detrusor urinae muscle

* Includes 24 cases in addition to Säuferlin's 211, since we assume he included his 6 cases in his analysis.

and a weakened or paralyzed constrictor muscle. Prolapse is considered a true hernia by Hepburn, the result of strain on con-

Fig. 1. Prolapse of the female urethra immediately preceding operation. Note black gangrenous surface and constriction at base.

Fig. 2. Photograph two months after operation.

genitally poor tissues. In many cases no etiological factors can be determined.

PATHOLOGY

The pathology of any specific case will vary with the extent of the circulatory changes that ensue following the prolapse. The earliest changes consist of hyperemia and hypersecretion. Progressively, venous stasis and blood vessel dilatation will occur with subsequent thrombus formation and simultaneous edema. This is due to the rich vascularity of the submucous tissues that abounds in capillaries and large blood spaces. Hypertrophy of the mucous membrane then develops with consequent constriction and strangulation. Finally necrosis and gangrene will occur in advanced cases. On the pathological tissue thus established, ulceration, excoriation and bacterial invasion may be superimposed, with ultimate sloughing and possible metaplasia. Some or all of these changes may develop slowly or rapidly and will largely influence the clinical picture observed or the therapy to be employed.

Anatomically, prolapse of the urethra may be partial or complete. A partial prolapse includes merely the posterior wall, whereas, a complete procidentia includes the entire circumference of the mucous membrane and is sometimes termed circular prolapse. Of course, a true prolapse may be conceived as including the entire urethra up to the sphincter of the bladder, but this rarely if ever occurs. The lesion in question may be considered as a prolapse of a greater or lesser portion of the anterior urethra (Fig. 3). It must be definitely differentiated, however, from simple eversion of the urethral orifice, which is very common, especially in multiparae. The partial prolapse of the posterior lip of the urethral mucous membrane must be differentiated from caruncles of the urethra. The latter are almost always found on the posterior lip of the meatus

urinarius and are small benign tumors arising from the mucous membrane of the meatus (Gutierrez).

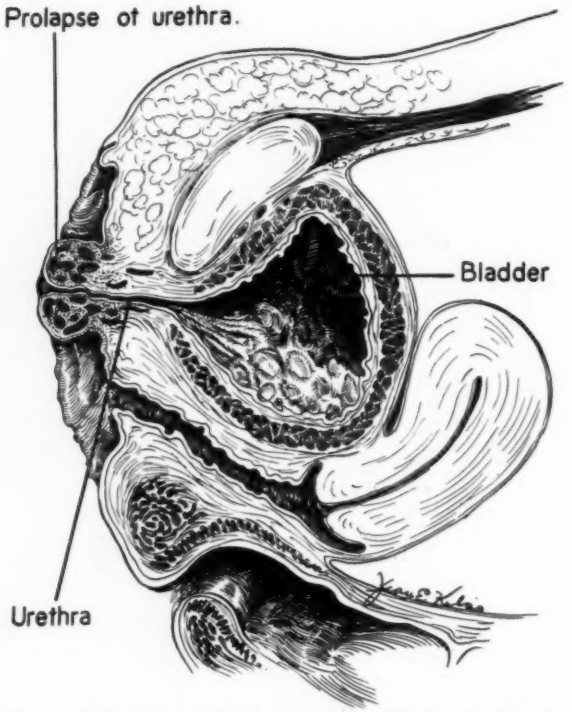

Fig. 3. Diagram of prolapse of the female urethra in sagittal section, showing pathological anatomy. Note multiple venous sinuses filled with thrombi.

The histological picture generally reveals marked thrombosis of the blood vessels, edema, atrophied connective tissue heavily infiltrated with lymphocytes, plasma cells, polymorphonuclear leucocytes, large mononuclear wandering cells and extravasated red blood cells. The most striking feature is the enormous number of blood vessels which resemble sinuses and are separated by narrow strands of connective tissue. They all show engorgement and beginning organization of thrombi. The histologic picture has been most often described as resembling that of an angioma or a hemorrhoid.

SYMPTOMS

The cardinal symptoms are urethral tumor, pain and bleeding, in addition to urinary disturbances. The size of the tumor varies greatly and has been multifariously described as ranging from that of a pea, through all the different nuts and berries to that of a pigeon's egg. Actual measurements reveal a range of from 0.75 to 4 cm. in length and up to 5 cm. in width. The color of the tumor mass may vary from the pale red of edema through the bright red of inflammation and the violaceous color due to constriction, to the black accompanying gangrene. The tumor's consistency may be either soft or firm and fleshy; and in form it strongly resembles a mushroom.

The urethral pain varies from a mild burning or itching to severe distress in the presence of urethritis or ulceration. Patients may be compelled to walk with their legs wide apart due to irritability of the tumor and vulva. The pain will be aggravated by examination or coitus though there may be no tenderness to touch. Chafing of the thighs and vulva is a frequent complaint.

Bleeding is the outstanding complaint, being present in at least 50 per cent of cases. A bloody serum may exude from the involved parts or a persistent bleeding may be present, the extent or degree of which depends on the circulatory changes that have occurred.

Burning on urination with varying degrees of frequency is a common symptom. There may be either retention of urine or incontinence, occasionally alternating with each other. Reflex anuria has been noted. Very severe pain on urination is sometimes the outstanding complaint.

All symptoms are highly variable and some cases are remarkable in the scarcity of symptoms they present.

DIAGNOSIS

The diagnosis is not always made readily, many missed or incorrect ones being recorded. Essential to the diagnosis is the finding of the relationship of the urethral canal to the mass. The urethral orifice should be the very center of the tumor. The size, color and consistency may vary as described. A history of sudden onset is

significant and is considered by some as pathognomonic. Digital palpation should be used to rule out vulval or vaginal lesions that may simulate prolapse. Wherever possible endoscopic and cystoscopic measures should be employed to obtain a complete picture. Chute found malignant disease of the bladder in 4 instances of partial prolapse and is a strong advocate of cystoscopy in all cases. Wherever possible, urethrograms should be made for differential diagnosis.

The differential diagnosis should include polyp, papilloma, caruncle, eversion of meatus, condyloma, urethral or periurethral abscess, cysts of the urethra, urethrocele, protrusion of a ballooning ureterocele, bladder prolapse, hypertrophied urethral mucosa and, most important, carcinoma or other malignant neoplasms.

The following points may be mentioned in differentiating a true urethral prolapse from the mentioned affections:

1. Polyps are usually multiple and are more deeply situated in the urethra; they are cystic and filled with a watery fluid;

2. Papilloma is a benign pluriglandular growth which may also arise from any portion of the urethra and would not possess as a rule the circular character of prolapse;

3. Caruncles are usually limited to the posterior lip of the meatus and are of a chronic character and are small raspberry-like soft red tumors very sensitive to touch; some authors believe they may be provocative of a prolapse;

4. Eversion of the mucous membrane of the meatus is common and may make differential diagnosis difficult; it is circular, but is whitish and "pouts," can be readily replaced, gives rise to few symptoms, and does not contain true urethral mucosa or submucosa;

5. Condyloma presents a warty, fungoid appearance, is multiple and painless;

6. Abscesses and localized infections may be ruled out by the history and the finding of pus and the relief attained by its release;

7. Urethrocele, which may be confusing, is a herniation of the urethral body through a tear in the urethrovaginal septum, and will present itself as a bulge in the anterior vaginal wall just behind the meatus urinarius, (Watkins); urethrography and urethroscopy should clinch the diagnosis;

8. Hypertrophy of the urethral mucosa presents a hardened mucosa that does not bleed;

9. Bladder prolapse presents a larger surface which consists of the thick walled vesical mucosa;

10. Carcinoma is the most commonly mistaken lesion, and it is occasionally necessary to have a biopsy to exclude it. The sudden onset with rapidly appearing surface changes of the true prolapse and its bluish red color should aid in ruling out the malignancy. Malignancies are indurated, develop slowly and metastatic inguinal nodes make their appearance early. The average age at which carcinoma of the female urethra is seen is fifty-three years.

11. Tuberculosis and syphilis should also be considered.

PROGNOSIS

The prognosis is generally favorable. Early diagnosis and proper treatment should give a good result. However, recurrence of the prolapse is not uncommon and residual symptoms are apt to remain. The factors that unfavorably influence the outcome are urinary infection, sepsis, hemorrhage, gangrene and embolism. Thurn-Rumbach and others have reported fatalities from embolism following surgery.

TREATMENT

Many methods of treatment have been recommended covering a range from the most conservative of simple reposition to radical procedures entailing abdominal section and highly technical plastic repair. In any method one must remember the richly vascular nature of the tissues in-

volved and exercise due caution against infection and embolism. The prevention of stricture formation should also be borne in mind.

In early cases conservative measures may be used. These consist of simple reposition by finger pressure or passage of a large well lubricated catheter (André). Continuous pressure may be employed by retention catheters and tampons. The local application of astringents and caustics has been used but generally, with poor results. However, Murray reports good results in 4 cases by this method employing adrenalin and chloretene ointment. Fulguration of the prolapsed tissue is recommended by v. Bissell; Livermore reports cures in 2 cases by this method. Ormond successfully employed the radioknife in amputation, but records the subsequent development of a urethral stricture.

Many operative procedures have been employed because of the tendency to recurrence after conservative measures which involve prolonged periods of treatment. Cauterization formerly frequently used, is now avoided because of the resultant stricture formation. Amputation of the prolapsed mucosa is the most frequently employed surgical attack. A catheter is inserted into the bladder and a piece of catgut or silk is tied around the catheter encircling the prolapse at its base or point of constriction. The prolapsed tissue ultimately necroses and sloughs away. Pollak and Klement successfully used this method in conjunction with electrocoagulation.

A variety of plastic operations have been devised. Most of these entail an approach through the anterior vaginal wall along the course of the urethra. The operations of Knauer, Singer, and Pinkus involve the excision of some of the anterior vaginal wall. Emmett's so-called "button-hole" operation consists of retracting and excising the prolapsed membrane through an anterior vaginal incision, and shortening the constrictor muscle. The latter is well illustrated by Keefe, who, however, recommends a procedure that aims at uniting the torn muscle fibers in addition to which he places a submucosal "pursestring" suture around the meatus. Hunner, commenting on the latter, advises suturing the internal sphincter also, for a permanent result. Kleinwächter splits the urethra, finds the point of separation of the mucosa, excises the excess, and then unites the outer and inner edges. A similar method is that of Kelly who amputates the mucosa and approximates the edges.

Hepburn reports successful results in 3 cases with his ingenious suprapubic approach. In this operation the bladder is lifted up through a suprapubic incision until all the prolapsed mucosa has been withdrawn into the urethral canal, the bladder neck then being anchored to the posterior fascia of the rectus muscle and the periosteum of the pubis. This operation is obviously only possible in the absence of any great degree of infiltration and thrombosis or other circulatory changes and in the presence of a readily reducible membrane.

Although the surgical approach is the one largely emphasized, for an ultimate satisfactory outcome it is vital not to neglect the general nutritional state of the patient and other associated etiological factors.

SUMMARY

Prolapse of the female urethra is a comparatively rare lesion, only 299 cases being reported in the past two hundred years. An additional case, in which gangrene developed, is reported herewith. The lesion occurs at the extremes of life, and is attended by symptoms of urethral tumor, pain and bleeding in addition to variable urinary complaints. All forms of strain will produce a prolapse in anatomically weak or asthenic, chronically ill women and female children. The treatment may be palliative or surgical, the latter usually being employed and most often consisting

of amputation and suture of the free edges. No one method can be advocated, to the exclusion of others. Conservative measures should be attempted first, as a definite mortality rate, surprisingly enough, attends radical procedures.

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* Report of 2 cases not included in the statistical analysis.

MASSIVE URETHRAL CALCULUS

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CALCULI originating in the kidneys or bladder that have been arrested in their outward passage behind

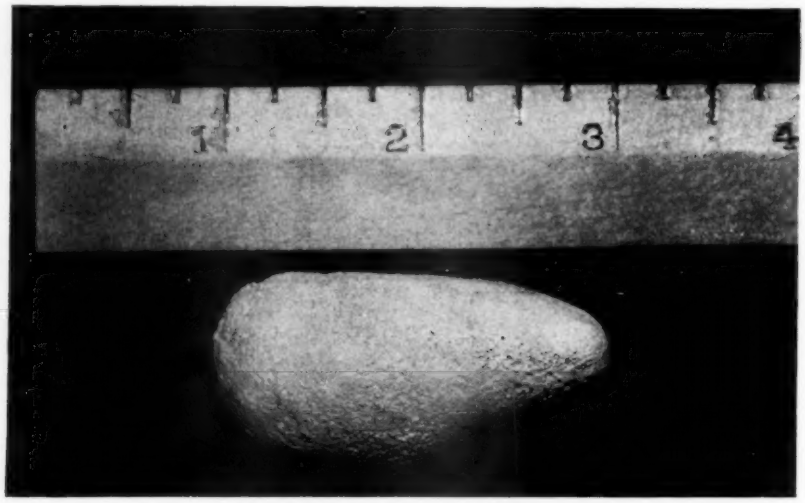

FIG. 1. Massive urethral calculus.

urethral strictures are not uncommon. They are usually of moderate dimensions and in long standing cases may be imbedded in the urethral wall or in a diverticulum of the urethra which may contain many stones. No doubt the missionary surgeons of the Orient have encountered urethral stones of the proportions found in this case but it must be an extremely rare happening. Horwitz, in Keen's Surgery,* pictures a stone closely resembling this one reported by Cotterill, of Edinburgh, removed from the prostatic and membranous urethra of a man forty years old, who had undergone lithotrity some six years previously. That my patient could have carried his huge stone a year or more with very little discomfort seems incredible.

T. H., aged fifty-two years, male, colored, freight trucker, complained of difficult urination, bad smelling urine, and "knot" behind his scrotum. Five years previously a heavy bundle had been dropped on a hand truck and its handle had flown up and hit him in the perineum. Pain and local swelling followed and his urine was bloody for several days. Sounds was passed by his doctor a number of times and he was told that unless this was done regularly he might develop a stricture. Because this procedure was painful he stopped treatment. He got along well enough until about a year before he came to me but since then he had noticed a slowly growing "knot" and a gradual increase in difficulty in urination. He found that pulling the "knot" backwards and to one side made his urine pass more freely. For several weeks he had felt tired and weak and his urine had smelled badly.

Physical examination showed a middle aged, well nourished, colored man. His pupils were fixed and his knee jerks sluggish. Just behind the scrotum in the midline and extending back along the course of the urethra to the triangular ligament, was a large hard mass about 2 by 1 inches and slightly movable. It seemed too large for any foreign body inserted through the urethra. Roentgenogram demonstrated a huge shadow in the perineum, evidently a stone. The urine had a specific gravity of 1012, a trace of

* Keen's Surgery. Phila., W. B. Saunders Co., 1908, Vol. IV, p. 512.

albumin and numerous leucocytes. The blood Wassermann was strongly positive.

Under ethylene anesthesia an inch and a half incision was made exactly in the midline over the mass. The membranous urethra was opened and the stone easily lifted out. The roof of the urethra seemed to follow the normal course, the floor and lateral walls being enormously distended but everywhere lined with smooth mucosa. The front of the stone was blunt nosed and fitted against a very moderate thickening and narrowing of the urethra, probably the result of the injury. The narrowing easily admitted a 16 F. sound. An 18 F. sound was passed and an indwelling catheter placed through the penis and the incision loosely closed with interrupted sutures of chromic gut with dermal in the skin.

His temperature was 102.6 on the first postoperative day and normal by the sixth. He leaked some urine through the perineum on the second day. The indwelling catheter was removed on the fifth day. The perineal wound broke down completely. The wound was granulating on the twelfth postoperative day and he was passing one-third of his urine through his penis. In three weeks only a few drops came through the perineum and in a month it was healed firmly and he had a free stream. He has refused the passage of sounds.

The stone was straight on the dorsal surface. It measured 5.5 by 3 by 2.5 cm. and weighed 32 grams. The end in contact with the stricture was smooth, the remainder of its surface granular.

SUMMARY

A case of a huge urethral stone in a colored man of rather low intelligence is reported. He had very little discomfort from this calculus and its removal was followed by perfect relief.

SPERMATOZOA IN URINE*

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THE fate of the millions of non-ejaculated spermatoza in continent men, is, to the present time, an unsettled problem. One of us[1] recently reported observations on the emptying of the vas deferens and seminal vesicle following injection of iodized oil through a scrotal vasotomy. Serial vasoseminal vesiculograms made in two impotent castrated men had demonstrated that the contents of the vas deferens and seminal vesicle were emptied slowly at a more or less constant rate. These observations appeared to substantiate the theory that the vasa deferentia and seminal vesicles normally empty themselves of their contents by means of a slow constant flow into the posterior urethra, independent of, and in addition to, ejaculation.[2] In these experiments, however, the continuity of the vas deferens had been broken by a high inguinal vasectomy and by total castration for tuberculosis. In addition, objection could be raised that iodized oil, though bland and non-irritating to the mucosa of the seminiferous tract, might possibly have caused the vas deferens and seminal vesicle to behave in an unphysiological manner.

The next step, obviously, was to examine urine specimens of abstinent men for the presence of spermatozoa.

CASE 1. The urine of a normal continent young man, J. S., seventeen years old, was examined twice daily for a period of thirty days (August 1 to August 30, 1935). A specimen was collected on rising in the morning, and a second in the evening. The morning specimen usually represented an entire night's output. Twenty cubic centimeters of each urine specimen were centrifuged in two parts for five minutes at medium speed. The wet sediment was then examined for spermatozoa under the high dry objective. Following this, the slides were allowed to dry and were fixed and stained with .25 per cent aqueous gentian violet. These slides were minutely examined for spermatozoa and constitute a permanent record (Figs. 1 and 2). The young man examined is intelligent and cooperative. He kept a careful record of erections, ejaculations and emissions and was under close observation during the entire month of the experiment.

During this thirty day period, a total number of 60 fresh wet urine specimens were examined; 30 morning and 30 evening specimens. In these 60 fresh wet specimens non-motile spermatozoa were found nine times, or 15 per cent. If, however, the morning specimens of August 11 and August 24, which showed many spermatozoa following nocturnal ejaculations, are eliminated, the positive findings are reduced to 12 per cent.

A total of 56 fixed stained specimens were examined, and in 39 of these spermatozoa were found (70 per cent). Omitting, as before, the morning specimens of August 11 and 24, spermatozoa were found in 69 per cent of the slides examined.

In both the wet and the fixed stained slides, the percentage of positives was somewhat higher in the evening than in the morning specimens.

In the wet slides, spermatozoa were found in 11 per cent of the morning specimens, as compared to 13 per cent of the evening.

In the stained slides, spermatozoa were found in 63 per cent of the morning specimens, as compared to 74 per cent of the evening.

The *p*H of the urine specimens, determined from August 1 to August 19, varied between 5.0 and 7.5. There was no demonstrable

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relationship between the hydrogen ion concentration and the finding of spermatozoa.

Case II. This experiment was repeated with a second abstinent man, M.S., twenty-seven years old. He was a patient at the Montefiore Hospital, suffering from arthritis of the knees, hips and spine, and was in a spica cast. Daily morning urine specimens were examined for a period of twenty-three days (August 20 to September 12, 1935). The specimen of August 25 was lost through an error. The patient reported one nocturnal ejaculation on August 24 during the twenty-three day period and also kept careful record of erections.

A total of 19 wet centrifuged urine specimens were examined. Three of these showed non-motile spermatozoa (16 per cent). However, of the 22 fixed stained slides examined, 19, or 86 per cent, showed spermatozoa. Eliminating the morning specimen of August 24, following a nocturnal ejaculation, the percentage of positives remains 86.

In general, only a few spermatozoa were found on a slide after considerable search (Figs. 1 and 2). However, on two occasions (J. S., morning of August 9: and M. S., morning of August 22), they were present in large number in the apparent absence of any ejaculation, an occurrence which we have designated as a "spermatozoa flood" (Fig. 3). This finding suggests that after long continence an involuntary discharge of semen may be caused by pressure of bowel evacuation or by contraction of the smooth muscle of the ampulla and the seminal vesicles. This, however, cannot be considered a true ejaculation. Careful questioning and examinations on these two occasions indicated no knowledge or evidence of any nocturnal ejaculation.

Fig. 1. Photomicrograph of fixed stained urine specimen. J. S., morning of August 25, 1935.

Fig. 2. Photomicrograph of fixed stained urine specimen. M. S., morning of September 9, 1935.

Combining both cases, and omitting the 3 specimens following nocturnal ejaculations, a total of 76 wet urine specimens were examined with 10 positives, or 13 per cent. On the other hand, examination of 75 fixed stained specimens revealed spermatozoa 55 times, or 73 per cent.

DISCUSSION

Contrary to Paget's findings,[3] we have been able to demonstrate spermatozoa in the urine of abstinent men independent of ejaculation in about three-quarters of the specimens examined. Whether this is an important excretory mechanism for spermatozoa is not directly shown by our studies, since quantitative evaluation of the results

was not possible by the methods used. Several facts, however, do suggest that a rather large number of spermatozoa normally may find their way into the urethra, independent of ejaculation.

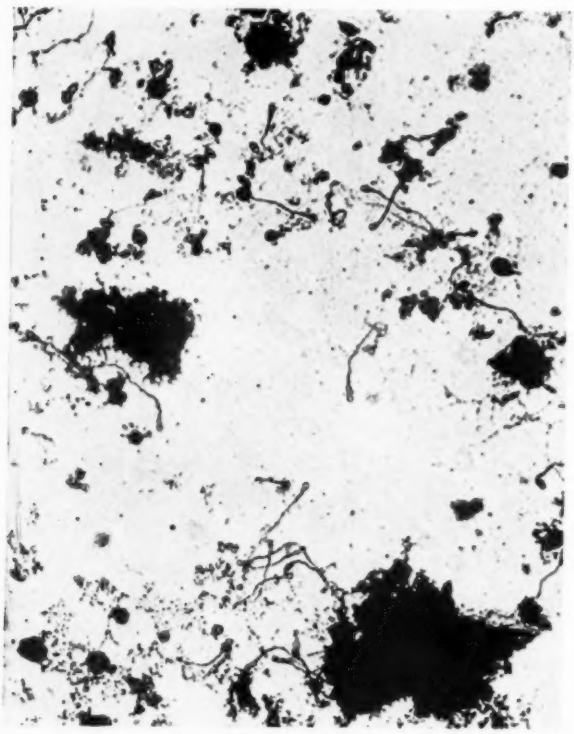

Fig. 3. Photomicrograph of fixed stained urine specimen. J. S., morning of August 9, 1935. Note "spermatozoa flood."

1. In the process of staining, the slides were flooded with dye and consequently a good deal of the smear was washed off.

2. The finished preparation consisted mostly of dense masses of heavily stained debris. Only occasional areas were sufficiently clear to search for and identify spermatozoa.

3. It would seem likely that in the process of centrifugation many spermatozoa were broken up and destroyed.

4. The action of urine may have destroyed a good many spermatozoa, since many of the specimens could not be prepared until they were several hours old.

5. A considerable number of atypical and abnormal looking forms were seen, which were probably spermatozoa, but which could not be identified positively as such. Such forms, though highly suggestive, were omitted from our statistics.

6. Finally, certain specimens did show large numbers of spermatozoa in the apparent absence of a previous ejaculation.

SUMMARY

Daily urine specimens of two abstinent men were examined for spermatozoa, both in the fresh wet and stained fixed preparations. Careful record was kept of ejaculations and erections.

In a total of 76 fresh wet specimens examined, spermatozoa were found 10 times in the apparent absence of ejaculation, or 13 per cent.

In a total of 75 fixed stained preparations of these specimens, spermatozoa were found 55 times in the apparent absence of ejaculation, or 73 per cent.

The demonstration of spermatozoa in about three-quarters of the daily urine specimens examined in continent men, apparently independent of ejaculation, is offered as evidence to substantiate the theory that the seminiferous tract normally empties itself to some degree by means of a slow flow into the posterior urethra, independent of, and in addition to, ejaculation.

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OSTEOMYELITIS OF SPINE

REPORT OF A CASE OF UNUSUAL LOCALIZATION*

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INFREQUENT contact with any disease renders it difficult to understand and treat and is considered only after every other diagnostic possibility has been exhausted. A recent case of osteomyelitis of the spine accentuated this phase of the problem and despite available literature presented its own unusual aspects thus offering difficulty in diagnosis. With a view to suggesting stress on one or two points as an aid in the diagnosis and also to record this case in the literature we submit this communication. The rarity of osteomyelitis of the spine is best realized by the fact that Hahn, as quoted by Wilensky,[10] reports a frequency of 0.2 per cent in a series of 661 cases of osteomyelitis of various regions of the body and the highest percentage, that of Wilensky,[10] is 1.5 per cent.

It has been stated repeatedly that the arches, spinous and transverse processes are usually involved in the dorsolumbar region and the bodies in the cervical region.[1,10] Steindler[9] states, however, that it has been his experience that the bodies were involved more frequently and we have had the same experience on the Orthopedic Service at Bellevue Hospital.

There have been occasional cases of disease of the bodies of the vertebra, but this is the first case we have noted in which the articular facet or neural arch was involved. If such is the case, Donati's observation, as quoted by Wilensky,[10] that mortality reached 78 per cent in disease of the bodies as compared with 33 per cent in disease of the arches, assumes a newer and more serious aspect when considering this condition.

It is accepted etiologically that in these cases we are dealing with a bacteriemia, following a skin infection, furuncle, upper respiratory infection or some such focus. As Kulowski[4] remarks, blood cultures are only infrequently positive, though the Staphyloccus aureus is the most commonly cultured organism when one is found. The symptoms vary widely[2] from those of a severe general sepsis to the mild chronic form. In the former, the profound toxemia, chills, high temperatures and rapid downhill course completely fill the picture and any local symptoms related to the spine are incidental since the outcome is usually fatal.

The chronic low grade case offering the greater difficulty in diagnosis and the better prognosis in response to treatment concerns us more.

Pain in the region of the lesion has been noted frequently and is usually of a deep, boring character, more severe at night. Tenderness in the area is also usually present. Limited motion in the spine on attempted movements may be evident and very often there is an accompanying moderate elevation of temperature. Mild urinary findings, as frequently found in these cases and probably related to the septicemia, cloud the issue even more.

At this point a diagnosis of renal or perirenal pathology is made more frequently and our own case is no exception to that interesting, if humbling, fact. Kessler, Bennetts and Bacon[3] report no less than 3 such cases in which the final diagnosis was osteomyelitis of the spine.

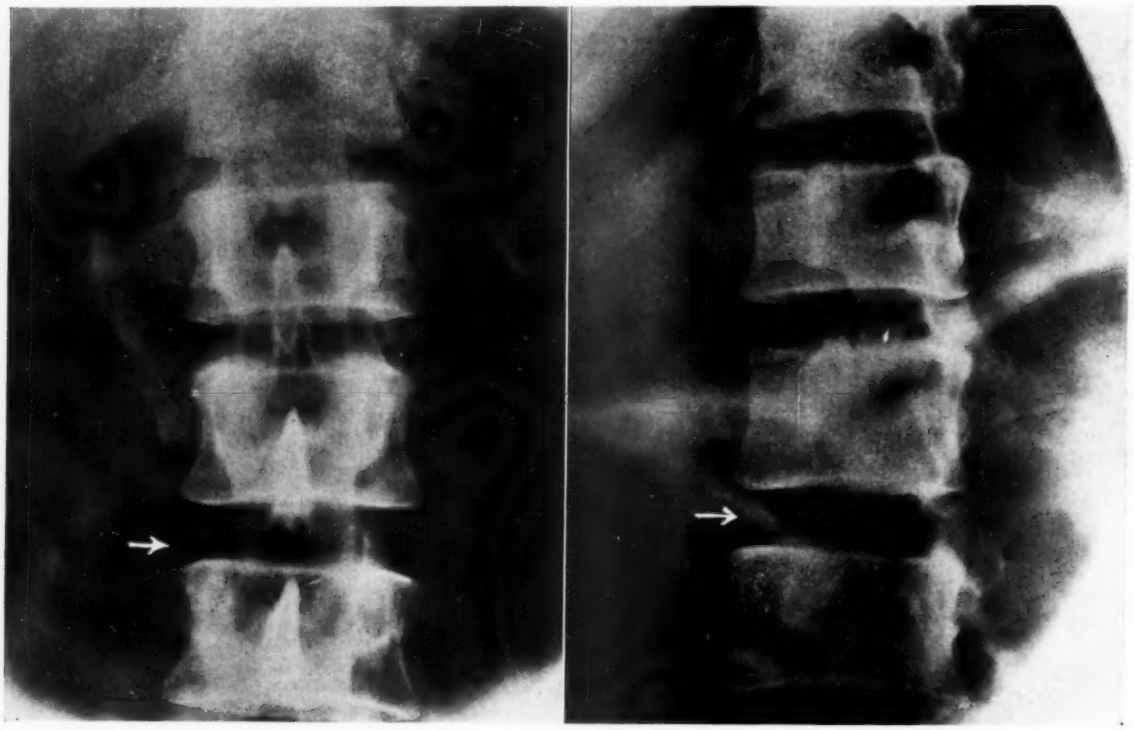
It is here, however, that in reviewing the literature on the subject a fact presented itself which is of service in diagnosis. Many case histories in this condition record notation of early pain in the thigh or leg, the hip joint or about the knee and subsequently the lesion presents itself in the

* From the Orthopedic Service of Bellevue Hospital, New York City, under the supervision of Dr. Arthur Krida.

lumbar spine. In several cases, as in our own, it has been the first complaint though little stress was placed on it. Wilensky[10] mentions radicular pain among the symptoms and this, from a differential point of view, is very valuable.

The anatomical relationship of the kidneys, their surrounding structures, the lateral spinal muscles and the vertebral column itself precludes any except the very remotest possibility of perirenal pathology encompassing the nerve roots to produce radicular pain. On the other hand, disease of the spine, especially when involving the neural arch at any point, may readily exercise pressure upon the nerve roots as they pass through the foramina, due to the beginning inflammatory edema about the region. The immediate effect of this in most cases, is radicular pain and will apply to the cervical and dorsal region, as well as to the lumbar region, in somewhat less degree, since the lumbar foramina present smaller diameters.

X-ray findings in these cases, especially when early, are notoriously negative. The case herein reported was similar. A careful recent recheck of early plates reveals no evident bony pathology and we include a set of pictures revealing the destruction, as a matter of interest and because we were fortunate enough to obtain this evidence on late plates. It is important to note that oblique views through the spine are essential for a satisfactory visualization of this particular pathology. The usual anteroposterior and lateral views are not sufficient.



A B

Fig. 1. Plates taken Oct. 31, 1935; A, anteriorposterior view, revealing the pathology of third lumbar superior articular facet on the right side. B, oblique view more clearly demonstrating lesion.

In reviewing the literature we were able to find 8 cases similar in anatomical pathology to the one we present.

Makins and Abbott[7] in their series of 21 report 4 such cases; one of Lucas, in which the posterior arch of the atlas was involved; one of Morian's, involving the arch and body of the twelfth dorsal vertebra; one of Müller's encompassing the arch of the second dorsal and one of their own in

which the posterior arch of the third lumbar was involved. Wilensky,[10] in addition to these, reports one of Deverne's involving the lamina of L-3 and one of his own in which the lamina of D-2 was affected. Lazarus,[5,6] in 3 cases of osteomyelitis reports one in the lamina; and Raiga[8] in a series of 3 cases reports one involving the articular facet and lamina of the fourth lumbar vertebra.

Treatment after diagnosis in the cases of this type, is incision and evacuation of the pus and removal of any sequestrum, this last again, being a rare finding. Following this, adequate drainage and general hygienic measures are necessary as these patients usually have had a long, discouraging and debilitating siege.

CASE REPORT

J. F. B., a forty-eight year old male, American, a private chauffeur by occupation, entered one of the medical services of Bellevue Hospital on September 4, 1935, complaining of pain in the right hip and lower back region. The history extended back to ten days prior to admission, when a dull throbbing pain developed in the right hip and remained for about a day and then was noted also in the "small of the back." At this time the temperature by mouth was 102. to 104. Sweating at night was profuse and the patient remained in bed during the ensuing days. After about three days the pain became more severe in the right hip region and was referred down the thigh to the right knee joint. The patient, at this time, thought there was some swelling and slight stiffness of the right hip joint area but no redness. The pain was more severe during the night. There was never any associated headache, anorexia or vomiting. After about six days of this sort of syndrome the patient came to the hospital for admission.

Further history at this time revealed occasional gaseous eructations related to the gastrointestinal system. In the genitourinary system, no hematuria, nocturia or dysuria were present. Venereal infection was denied.

Examination on admission revealed a well developed and nourished white male, complaining of pain in the right sacroiliac region. He was not acutely ill. No tenderness or increased heat was noted in the lumbar region. The right thigh was not tender or swollen. Very slight tenderness in the right sacroiliac region was present and hyperextension of the right lower extremity produced pain in the right sacroiliac region. Slight costovertebral tenderness in the right side of the back and moderate scoliosis of the spine to the left in the lumbar region were noted also.

The remainder of the general examination was negative other than for postpharyngeal redness and injection with some increase in the size of the tonsils. Temperature was 101, and pulse rate 100.

Blood count on admission showed 11,600 white cells and polymorphonuclear 56 per cent, lymphocytes 34 per cent, and band forms 10 per cent. This was the highest per cent at any time during illness. Later counts were all under 10,000 with similar differentials. The urine was negative.

X-ray films of the chest and hip were negative on admission.

Further progress in the hospital was as follows:

The pain continued for a week or two weeks about as on admission. The temperature ranged from 101. to 102. or 103. daily until October 1, almost four weeks after admission.

During this time *x*-ray films of the spine, a gall bladder series, pyelograms and barium enema plates were all negative. The urine was negative daily until September 22, 1935, when many red and white cells appeared with albumin and hyaline casts. Similar reports were present until October 4, when it again became negative.

Spasm in the right lumbar muscles was noted on September 14, 1935, and urological consultation on this day resulted in an opinion of a mild pyelitis but no surgical kidney.

Agglutination test for Baccillus melitensis, Widal test and blood Wassermann were all negative. Blood chemistry was normal.

On October 2, a Staphyloccus aureus was cultured from the blood; this was noted on the last day of the elevated temperature at 102.6, and was the only positive blood culture throughout the illness.

The sedimentation rate was 1 mm. per minute.

The patient improved greatly, felt quite well and was allowed out of bed on October 19. That evening his temperature was 101. and

his urine of the same day contained many white blood cells in clumps and red cells. The patient was confined again to bed. The temperature remained between 101. and 103. during the next week. Pain in the right lumbar region appeared and a moderate scoliosis and spasm of the right lumbar muscles returned. An impression of pylonephritis remained.

On October 31, the patient complained of further and more severe pain in the right lumbar region. Considerable tenderness in the right flank and limited motion in the spine were present and a sense of fullness was noted to the right of the spinous processes of L-2 and L-3. *X*-ray films the same day reported slight scoliosis of the lumbar spine; the right psoas muscle was obscured.

The orthopedic consultant concurred but suggested further *x*-ray plates and aspiration over the region of fullness. It was felt the process was definitely related to the spine.

New *x*-ray plates revealed three small areas of calcification between D-12 and L-1, with absorption and fragmentation of the superior articular process of the third lumbar vertebra on the right. The next day 5 c.c. of thick creamy pus was aspirated from the right lumbar region which on culture showed Staphylococcus aureus.

The patient was transferred to the Orthopedic Service.

On November 8, 1935, under gas anesthesia the lumbar region was incised and drained through a four inch long incision about two inches to the right of, and parallel to the spinous processes from L-2 to L-4 level. About eight ounces of thick, yellowish-white pus was obtained from a deep pocket directed along the side of the spinous process of L-3. At the junction with the lamina on the right side the pocket turned medially and a sequestrum about 1.5 cms. long was removed from the region of the articular process. The wound was closed with drainage by inserted packing and rubber tissue.

The temperature from the first postoperative day until discharge from the hospital was flat. The urine postoperatively displayed a few clumps of white blood cells. This was the last evidence of any kidney disorder. The patient made a very uneventful recovery and was discharged on December 14, 1935, wearing a close fitting Knight spinal brace with slight drainage from the back wound persisting.

Seen weekly for the first month and once every two weeks afterward, the drainage had ceased entirely one month after discharge from the hospital.

When last seen in early March, 1936, the patient had returned to work as a chauffeur. He had gained 30 pounds and had no symptoms whatever in his back.

COMMENT

In view of the similarity of this case in many ways to several reviewed in the literature, attention is drawn again to the early symptoms of radicular or referred pain. This man's early complaint was of great pain in the hip joint and thigh region on the right side. While these might be toxic manifestations in this area, it is more reasonable to suppose it was of a radicular nature since the area corresponds anatomically to the distribution of the second and third lumbar nerves, the region which subsequently showed the spinal involvement on the right side. It is hard to believe that such symptoms would have accompanied a condition of pure renal or perirenal origin.

Another diagnostic point is suggested for more frequent use than heretofore employed in such cases. Aspiration, while performed quite late in this case, made further speculation unnecessary and stressed the need of drainage at an early date. It is quite possible that if it had been performed earlier in the course of the condition a shortened period of hospitalization would have resulted. The pain at the level of L-2 and L-3 in the light of subsequent findings would warrant, surely, the use of this procedure where indicated. It would reveal the true nature of the presence of an abscess long before the heavy musculature in the region of the spine permitted recognition on the surface.

The mild pyelitis present seems to run parallel to the usual course of events as noted elsewhere. It does not seem within the scope of this paper to discuss it except as a source of distraction from the more important focus, the spine. The renal path-

ology encountered, it is felt, was one of the milder manifestations of a low grade blood infection with an undiscovered origin, but with its point of greatest localization in the neural arch of the third lumbar vertebra. The subsequent course and immediate recovery of the patient following treatment directed to this area supports this.

CONCLUSION

The importance of radicular symptoms is stressed as a diagnostic aid in view of the close anatomical relationships between the vertebras, especially the neural arches, and the nerve roots; also the inclusion of aspiration in this condition as in so many others in which a purulent process is suspected. It is to be hoped that by the use of all of our armamentarium in cases of such admitted rarity an earlier diagnosis, so important to the welfare of these patients, may be reached and thus earlier cure effected.

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MEDULLARY CARCINOMA OF BREAST, FOURTEEN YEARS WITHOUT RECURRENCE: SCIRRHOUS CARCINOMA OF OPPOSITE BREAST*

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M. E., housewife, aged forty-seven years, was first seen on April 10, 1935, complaining of pain and a hard lump in the right breast. She had noticed a sensation of the nipple being drawn toward the midline for several months and had experienced pain for three weeks. At this time she noticed, also, a lump in her right breast for which she consulted a physician, who advised a mastectomy.

Previous history showed that the left breast had been removed on September 26, 1921, and it was learned that at that time she had a very extensive involvement of her left breast and the axillary nodes.

The pathological report from St. Luke's Hospital showed "the tumor to be a carcinoma with a tendency to form glands, but in other areas it was distinctly medullary in type, the growth as a whole showing great variation in morphology. The breast as a whole seemed to show many outlying areas of extension of the tumor aside from the original growth."

No history of carcinoma in the family was elicited.

The general physical examination was negative. The lungs were resonant throughout and no adventitious sounds were heard. Over the left side of the anterior thorax was the long scar of the previous operation, well healed, soft, not adherent to the underlying structures and showing no evidence of any recurrence. The corresponding axilla and supraclavicular space revealed no palpable nodes.

The right breast showed a very hard mass in the inner, lower quadrant, approximately 2 by 3 inches in size. The tumor was adherent to the skin which showed slight dimpling, but the breast was freely movable on the thoracic wall. The axillary nodes were not palpable.

Radical amputation of the right breast was done on April 18, 1935, the incision being carried well away from the edges of the tumor. The patient was discharged after an uneventful convalescence on April 27.

The pathological diagnosis by Bullock was "scirrhous carcinoma of breast, grade 2. No evidence of axillary involvement. Microscopic examination of sections through the nodules show carcinomatous tissue, the stroma of which is abundant, dense, and poor in cellular elements with areas of hyalinization. The tumor cells are, for the most part, of small size, polyhedral in shape and are arranged in narrow strands, thicker columns and irregular masses. Mytotic figures are seen, though they are not numerous. The growth infiltrates the skin and deeper part of the nipple.

"Metastases are not demonstrable in six lymphnodes which were found in the axillary fat."

COMMENT

This is a case where, fourteen and one-half years after radical mastectomy for a medullary carcinoma with axillary metastases, an independent carcinoma of a different type developed in the opposite breast. It is noteworthy that the majority of cases with axillary metastases at the time of operation do not survive more than a year or two. Exceptions to this, however, do occur.

DISCUSSION

DR. FRANK E. ADAIR (New York) stated that this is an interesting case in which Doctor Sauer has reported a rare circumstance, in that he has had the opportunity of studying the pathologic slides of not only the original tumor removed fourteen and one-half years ago, but, also, the tumor recently removed from the opposite breast. The tumor excised at the first operation was an adenocarcinoma, becoming infiltrating, grade II on the scale of malignancy. In certain areas of the tumor

* Presented at the New York Surgical Society, Feb. 12, 1936.

there was tremendous cellularity. This was, more especially noted in the metastatic areas in the axillary nodes where the tumor seemed to be even more malignant than in the breast. In the node capsule, and even extending slightly beyond the nodes, were areas of metastatic cancer cells. Therefore, a remarkably good result was secured in a case on the borderline of operability and offering an especially grave prognosis.

Fig. 1. Adenocarcinoma of left breast removed September, 1921.

Fig. 2. Scirrhous carcinoma of right breast removed April, 1935.

The pathology in the opposite breast, recently operated, shows a duct carcinoma. These cells differ from the first tumor. They are large, cylindrical, more opaque and granular with a great amount of old fibrosis. Of especial interest in the later tumor is that the microscopic picture shows all stages of transition leading from a perfectly normal lining cell up to the cancer cell. There are areas of papillary overgrowths in the ducts. The factors which create the impression of dealing with an entirely different process in the second breast are (1) that it shows all transitions from the normal cell to the cancer cell; (2) there is no trace of the first tumor; and (3) the cancer cells themselves are entirely different from the first type. Doctor Adair thought it safe to assume that this was not a late recurrence but an entirely new process.

The question of bilaterality of cancer of the breast always involves a problem difficult of solution. Cases of bilateral cancer occur under three circumstances:

1. Where there is metastasis to the opposite breast. It usually takes place in the mesial portion of the remaining breast. The lesion is usually manifest within two or three years after the operation. The histopathology is identical with the lesion removed at the first operation. It is due to cross lymphatic extension.

2. In connection with bilateral nodular hypertrophic mastitis. Although this is rare, this type is occasionally seen. The history is that the patient has had bilateral fibrous nodular breasts for a long period. Malignant changes become manifest in both breasts at about the same time, and usually in the tail of the breasts.

3. In circumstances similar to those presented by Doctor Sauer's patient. This is a rare type. However, there are instances of carcinoma of one breast possessing multiple primary foci. These are well recognized. The several foci of origin seem

to have no possible connection with, or extension from, each other, at times even being widely distant from each other. An example of the latter condition of more than one focus in the same breast is afforded by certain cases of Paget's disease of the breast, where there is one malignant process in the nipple and areola, and another, entirely different malignant process in the depths of the breast, entirely separate, disconnected and even differing histologically from the nipple process.

All the factors responsible for the production of mammary cancer are not known. If they were, the explanation of bilaterality would be obvious. However, within the past twenty years there has been an enormous amount of study regarding the etiology of this major form of cancer. The experimental contributions from the laboratory together with the careful study of the various clinical factors in each case, have made available the information that mammary cancer is not due to one cause but to several causes; and in all probability to one or more factors working on the other. It is widely conceded that the ovarian hormones play an important role in causation. This is shown not only in the laboratory where castrated female mice fail to develop mammary cancer, but it is shown also in clinical medicine where, for many years, it has been well recognized that mammary cancer develops but rarely in ovariectomized women. Folliculin and lutein hormones from the ovary, and prolactin from the hypophysis, circulating in the blood, greatly influence the cellular behavior of mammary tissue. It is thought, however, that this influence is greatest when the soil—the mammary tissue—is altered by such influential factors as those resulting from duct stagnation and irritation secondary to non-nursing, to obstruction from scarring of abscess formation, to miscarriages, to inverted nipples, the non-establishment of breast function, etc. The third great important factor is the "constitutional factor" which is the inherent attribute which must be taken into consideration in all cases.

It is that which makes the difference in the percentage of cancer incidence in breeding experiments. In one strain of mice these breeding experiments give consistently a definite percentage of mammary cancer, while in another mouse strain the same identical experiments produce consistently several times as many cancers.

Cancer of the female breast is dependent, therefore, on at least three factors, each working on the other, namely, hormones; stagnation and irritation; and the "constitutional factor."

DR. CARL EGGERS (New York) said that cases like the one presented by Dr. Sauer, of adenocarcinoma of the breast fourteen years without recurrence, and then followed by a scirrhous carcinoma in the opposite breast, are of interest from the clinical as well as from the pathological standpoint. One should not feel discouraged too much when a patient develops a tumor in the opposite breast, or has a tumor in both breasts at the time. It is not necessarily a bad sign. There are of course cases in whom bilateral involvement indicates advanced disease and who run a rapidly fatal course. On the other hand there are also cases in whom the prognosis seems to be no worse than in unilateral involvement. The condition is not uncommon and I have had a number of cases in my own practice that have brought out interesting points.

About two and one-half years ago, closely following one another, were 2 patients, one sixty-three and the other seventy-four years of age. Both had a bilateral tumor and both of them clinically looked like carcinoma. In each case the breast on one side was apparently more extensively involved than the other with enlargement of the axillary lymph nodes. In the younger woman a radical operation was done on the more involved side, while on the other side a simple ablation with removal of the accessible axillary contents was done. Both tumors were reported

scirrhous carcinoma with axillary involvement on one side. In the older patient a radical operation was also done on the more involved side, but on account of her age her family physician would not permit more than a wide local excision of the tumor of the opposite breast. Both tumors were reported scirrhous carcinoma without axillary involvement on the radically operated side. Both patients have remained well to date. These cases illustrate the well known fact that if one is fortunate enough to get patients before the tumor has invaded the surrounding tissue, or has extended along the lymphatics to the nearest lymph nodes, a less radical procedure than that usually employed, may cure them.

The oldest living patient in Doctor Egger's private practice with a bilateral carcinoma was originally operated on in March, 1927 at the age of thirty-five years. She had involvement of one axillary lymph node. In May, 1933 he performed a radical operation for carcinoma of the opposite breast. There was no axillary lymph node involvement. So far there have been no further signs of disease.

In still another patient, sixty-three years of age, scirrhous carcinoma of both breasts developed at an interval of less than a year. Both were treated by radical operation and on neither side was there axillary involvement. The patient was an old cardionephritic case and succumbed to this condition in 1931, about five years after the second operation. There was no clinical evidence of recurrence, but as there was no autopsy performed, a positive statement on this point is not possible.

About six years ago in March, 1930 Doctor Eggers performed a radical operation for carcinoma of the left breast on a patient sixty-one years of age. Extensive axillary involvement was found but in spite of that she remained well until May, 1935, when she discovered a lump in the opposite breast. This was likewise treated in a radical manner and was reported as multiple carcinomata, Grade 2, without evidence of axillary involvement.

Whether in such bilateral involvement the tumors appear to be identical in structure or whether they vary somewhat, makes very little difference. The interesting question remains whether the second tumor is a metastasis from the first one, or whether it is an independent tumor. In a case like Dr. Sauer's, with an interval of fourteen years, and definite pathological evidence of difference in structure, one may assume that we are probably dealing with independent tumors. On the other hand it is known that lymphatics frequently cross the median line and that occasionally one finds involvement of the opposite axillary lymph nodes. It is conceivable, therefore, that in a certain percentage of cases involvement of the second breast must be considered as a metastasis from the first breast.

DR. JOHN DOUGLAS (New York) felt that quite apparently Doctor Sauer was dealing with a separate, and not a metastatic tumor. One of the most interesting questions in connection with late metastases is where the cells have been during all the period before the metastasis occurred. In 1912 Doctor Douglas operated on a woman in St. Luke's Hospital for carcinoma of the right breast. To the best of his recollection the axillary glands were involved. In 1928, sixteen years afterward, she had pain in her left chest and an aspiration was done of this chest which was found to be full of bloody fluid. Roentgen examination showed a shadow filling her chest, but it was impossible to tell whether it was pleura or lung that was involved. Shortly afterward, she developed a very small nodule in the subcutaneous tissues in the left axillary line, quite away from the breast and on the side opposite to that in which she had had the breast tumor. This nodule was removed under local anesthesia and the specimen brought to St. Luke's Hospital where slides were found to be identical with those made from the tumor of the woman's right breast sixteen years previously. The second tumor must therefore

have been a metastasis, and it must have metastasized in the left chest. Where were those cancer cells during the sixteen years before they started to develop?

DR. WM. BARCLAY PARSONS, JR. (New York) cited an interesting case in his experience. Seventeen years before he saw her the patient had noticed a lump in her right breast. She had consulted a doctor about it but he told her to forget all about the lump. Being a thoroughly model patient, she did. Then, during the course of a bronchitis, seventeen years later, the physician examining her discovered the lump in the right breast and when Doctor Parsons saw her, he noted an identically placed mass in the other breast. Each lump was in the axillary tail and were of the same size. Each tumor turned out to be a scirrhous carcinoma. It is impossible to determine whether the lump in the right breast was carcinoma all of the seventeen years or whether the patient had had the lump in the left breast for seventeen years, but the fact remains that she did have a tumor in her right breast which did not grow in the seventeen years since it was first noted. Operation was done nine years ago and has been followed by no recurrence. Individuals who happen to produce the type of tumor that is extraordinarily slow in growth and metastasis, are, of course, most fortunate, and one might speculating upon whether, in long follow-up cases, the good result is not due more to the particular habit of the particular tumor than to the surgeon's good fortune in getting outside of the margin of spread at the particular moment of operation.

DR. SEWARD ERDMAN (New York) asked whether the theory of the effect of ovarian hormone on breast tumors, practiced some years ago in Boston, was still being utilized as a basis for advising oophorectomy in cases that are either hopeless from the standpoint of complete removal or in young women where metastasis is frequent. He wondered whether Doctor Adair had had experience with oophorectomy as a form of treatment for cancer of the breast.

DOCTOR ADAIR answered that a great deal of work along this line is being done at the present time and that the next five years should give forth some very interesting developments. He said that the work of Loeb in ovariectomized animals was outstanding and that Loeb had obtained very much reduced incidence of mammillary cancer in those cases that had had the ovaries removed.

DR. PAUL K. SAUER (New York) referring to Doctor Adair's emphasis that the second tumor in his case showed morphological variations from scirrhous to adenocarcinoma, said that Doctor Bullock, the pathologist at Lenox Hill Hospital, had cautioned him not to lay too much emphasis on the term "scirrhous." Most breast carcinomas do not show uniform structure, and the peripheral portions of most of the tumors diagnosed as scirrhous carcinoma are cellular, the parenchyma generally predominating over the stroma. As regards folliculin, I recollect two papers presented by Doctor Otto Pickhardt before the New York Surgical Society a few years ago; one on the experimental production of carcinoma in mice by the injection of large doses of lutein and the production also of chronic cystic mastitis. In the second paper, in trying to correlate this with humans, Doctor Pickhardt found that of 102 cases of chronic cystic mastitis at Lenox Hill Hospital only one patient had subsequently developed a carcinoma. That case was diagnosed only clinically because, for some reason, no histological examination was made. Doctor Sauer said that it is difficult to draw an analogy between animals and humans.

SUMMARY

1. Cases of adenocarcinoma of the breast with axillary involvement living fourteen and one-half years after operation are rare.

2. In this case no recurrence was noted, nor were metastases found, fourteen and one-half years after removal of the left breast for adenocarcinoma with extensive axillary metastases.

3. A second tumor, also carcinoma but of a different structure and without axillary involvement, was discovered in the opposite breast.

4. The pathologic slides of the first tumor fortunately were available for comparison with the slides of the second growth, thus facilitating the proof of two independent neoplasms.

5. There is no evidence to show that either tumor developed on the basis of chronic cystic mastitis.

Quackery (18th century), if not universal, was at least, in Thoreau's phrase, "universally successful." . . . In England, there was a long line of successful medical charlatans of both sexes. The earliest of these was Sir William Read, who started out as a tailor, but in 1694 set up in the Strand as an oculist, having someone to write a book on eye diseases under his name and a Grub Street poet to praise him in verse. His success in this specialty attracted the attention of Queen Anne, whose bad eyesight made her an easy victim of such imposters, and, gaining her good graces, he was actually knighted, subsequently becoming oculist to George I. He frequented the society of Swift and the other coffee-house wits, who made fun of him while accepting his lavish hospitality, and he is even mentioned in the Spectator (September 1, November 27, 1712).

Garrison's History of Medicine.

TRAUMATIC ARTERIOVENOUS ANEURYSM OF ANOMALOUS LATERAL SURAL VESSELS*

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ALTHOUGH traumatic arteriovenous aneurysms are not rare, a search of the literature does not reveal a report of a case of primary involvement of the lateral sural vessels. The following case is of additional interest since anomalous vessels are involved.

J. R., a fifteen year old white boy, was admitted to the University of Kansas Hospital, July 16, 1935. At the age of nine years he received a stab wound in the upper and lateral portion of the calf of the right leg which healed rather slowly and there was some flexion contracture of the knee for about sixteen months. Ever since the accident he had been conscious of the circulation of blood in the upper lateral portion of the right calf. There were no other symptoms until the ten month period before admission, during which time there was progressive enlargement of the calf and muscular cramps of the affected part on exertion. Some numbness and lack of warmth in the right foot were still later symptoms.

Examination. The circumference of the right calf was 1¼ inches greater than the left. A large varicose vein-like structure, fairly superficial, was easily palpable and extended from just below the insertion of the lateral head of the gastrocnemius muscle to a point in the midline of the calf at the junction of the mid and lower third. A marked thrill was felt on palpation of this structure and on ausculation a loud whistling bruit was heard which was accentuated during systole. The blood pressure at each cubital space was 134/30, at the right ankle 100/50, and at the left ankle 128/70.

Operation. (July 17, 1936.) Three large dilated vessels, intimately connected, were found emerging from the lateral head of the gastrocnemius muscle. Dissection revealed that two of these vessels entered the popliteal vein while the central one branched from the popliteal artery. After entering the gastrocnemius muscle these dilated vessels formed a structure about one inch wide and six inches long which terminated in numerous deep branches at about the junction of the mid and lower third of the leg and a little to the inner side of the midline.

FIG. 1. Sketch of arteriovenous aneurysm, lying in the lateral portion of the gastrocnemius muscle and connecting with the popliteal artery and vein at the proximal end and the posterior tibial artery and vein at the distal end.

* From the Department of Orthopedic Surgery, the University of Kansas School of Medicine.

The deep terminal branches connected with the posterior tibial artery and vein as illustrated in Figure 1. The plane of the aneurysm was the superficial portion of the gastrocnemius muscle, with a few muscle fibers covering the mass. The aneurysm was entirely removed between proximal and distal ligatures.

Gross Pathology. (Dr. R. H. Wahl.) The specimen consists of two dilated veins and an artery, the latter being in the center, and measures 3 cm. in breadth and 17 cm. in length. The external surface is roughened by fibrous adhesive tags. There are several small holes making communicating channels between the three vessels. The intima of the three is smooth, moist and glistening.

Histological Pathology. Section through the artery shows nothing particularly abnormal, although the walls are unusually wrinkled and the intima is increased in size. The adjacent veins show wrinkling and thickening of the intima.

Pathological Diagnosis. Arteriovenous aneurysm.

The lateral sural vessels were unquestionably involved in this aneurysm. The constancy of the location of the thrill, plus the location of the aneurysm, would seem to indicate anomalous sural vessels rather than change of topography, due to the formation of an arteriovenous aneurysm in an otherwise normal sural artery and vein.

The patient's postoperative recovery was uneventful, and he was symptom free when examined one year after operation.

SUMMARY

A traumatic arteriovenous aneurysm of the lateral sural vessels is reported because of the rarity with which the affected vessels are involved and the author's belief that, in this instance, the vessels were anomalous. There were no marked cardiac changes or elevation of blood pressure determinations. Excision produced a cure.

PRIMARY IDIOPATHIC THROMBOSIS OF AXILLARY VEIN*

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PRIMARY idiopathic thrombosis of the axillary vein, although rare, occurs as a distinct clinical entity. Matas,[1] in 1934, reviewed the literature on the reported cases, described a case that he observed and discussed the various theories as to the etiology of this condition. Since his study, several additional cases of axillary vein thrombosis have appeared in both the American and foreign medical journals.

As the name indicates, a thrombosis occurs along the course of the axillary vein, with resultant symptoms and physical signs due to interference with the circulation in the affected extremity, for which numerous theories have been advanced to explain its cause. In some of the reported cases there was a distinct history of injury to the arm; in other instances, the onset followed a severe effort strain, such as lifting a heavy object. In most of the cases there was no definite attributable cause. Loewenstein,[2] in his study, has suggested that the thrombosis was due to a partial constriction of the axillary vein by the costocoracoid ligament and subclavius muscle when the arm was sharply extended.

The onset is usually sudden with pain in the involved extremity; the arm becomes blue, cold and edematous, and dilated veins may appear over the chest and shoulder. The thrombosed vessel is felt as a distinct cord along its course and may be tender to pressure. Slight fever and leucocytosis may occur.

The prognosis is excellent. Under rest and elevation of the arm the symptoms gradually disappear, as a result of canalization of the thrombus or the establishment of a collateral circulation.

In the differential diagnosis, it is essential to exclude extravascular lesions such as tumors or inflammatory masses pressing on the vein, cervical ribs and intrathoracic growths.

CASE REPORT

History. D. H. was admitted January 30, 1936, complaining of coldness and numbness of the left half of the body of one day duration, and inability to move the left arm or leg. She also complained of severe pain in the left arm when attempting to raise it.

Examination. The general physical examination was negative except for the left upper extremity which presented a transverse line of ecchymosis on the anterior lateral aspect of the arm near the shoulder, above which the tissues appeared normal. Below this level, the extremity was swollen, cold and cyanotic. There was abnormal pallor present on elevation. The radial pulse was present and equal to that on the right side. The axillary vein in the left axilla for a distance of 3 inches was felt as a hard, indurated and painful cord. The reflexes were intact; motor and sensation were normal except for slight diminution to light pin prick and cotton stroking.

The clinical impression was that of a primary thrombosis of the axillary vein.

Laboratory Findings. The blood pressure was 124/88; the venous pressure in the right arm was 7.5 cms. and in the left arm 30 cms. The blood rose to the top of the tube which was 30 cms. above the cardiac level, and continued rising. The blood Wassermann was negative. *X*-ray studies of the chest, cervical spine and shoulder were negative.

Vasography of the vessels of the left upper extremity discloses arrest of the dye at a point where the basilic vein joins the axillary vein.

[1] MATAS, RUDOLPH. *Am. Jour. Surg.*, 24: 642 (June) 1934.

[2] LOEWENSTEIN, P. S. *J. A. M. A.*, 82: 854 (March 10) 1924.

* From the Surgical Service of the Hospital for Joint Diseases, New York City.

Below this level, the veins and valvular mechanism are clearly visualized (Fig. 1).

Clinical Course. On February 2, examination revealed that the edema and cyanosis were subsiding and the arm was slightly warmer, although a thick, tender cord was still palpable in the left axilla.

On February 6, the veins of the left arm and shoulder and upper extremity were markedly dilated and the skin was mottled, blue and cold. To exclude an extravascular mass compressing the vein, an exploratory incision was done under local anesthesia exposing the left axillary vessels. The vein was completely thrombosed; no blood could be aspirated. No glands or tumor masses compressing the vessel could be found.

The patient made an uneventful recovery, with gradual restoration of the arm to normal appearance except for the presence of some dilated veins over the upper aspect.

SUMMARY

A case of primary idiopathic thrombosis of the axillary vein is presented, with classical physical signs and proved by vasography. It is important to exclude extravascular lesions as a possible source of compression. These cases heal spontaneously with the reestablishment of the circulation.

Fig. 1. Vasography of the left upper extremity.

NON-PARASITIC CYSTS OF LIVER

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CASE REPORT

THIS case of solitary non-parasitic liver cyst occurred in a married white woman, Mrs. M. K., aged sixty-seven years, and the mother of four children, three of whom are dead. She entered Grace Hospital November 22, 1933, being forced to seek medical attention because of severe pain in the midabdomen which had persisted for about ten days. She neither vomited nor was nauseated, and had had no loss of blood at any time but she was constipated and had a slight cough. She had had no sicknesses except swollen feet in 1912. A mass in the abdomen was present for many years.

The physical examination showed a prominently distended abdomen which contained a large, tense, elastic mass about the size of a six months pregnant uterus. There was much general tenderness, with dulness prevailing in the midabdomen and tympany in the flanks. A mistake of omission was made here in that there were no notes on percussion of the upper abdomen. I was too sure that the patient had an ovarian cyst. The temperature at first was 101. but gradually dropped to normal by the day of operation, fifth day of admission.

The pelvic organs were normal, and the mass did not occupy the pelvis. Catheterization was done but the mass was not bladder. The examination of the head, mouth, neck and ears revealed only findings which any elderly woman would present. In the lungs were coarse rales over both bases, with good breath sounds and no dulness. The extremities were normal and not swollen. The report on the heart examination by the cardiologist is:

"The patient has a chronic cough which is worse in winter. There is no dyspnea or cyanosis. The chest is emphysematous with sonorous and large moist rales over both lower chests. The radials are thin and arteriosclerotic. The heart is not definitely enlarged. The patient has tachycardia and occasional extra systoles. The aortic second sound is loud, and there is an indefinite gallop rhythm. The blood pressure is 130 systolic, and 70 distolic. Abdominal arotic pulsation is increased. There is no edema.

"Electrocardiogram shows sinus tachycardia and arteriosclerosis. There is clinical evidence of myocardiac degeneration.

"*Advice.* Three days rest in bed with digitalization before operation; spinal anesthesia recommended."

For four days before operation the patient was treated for bronchitis and digitalized. The respiration rate was 24. She became slightly jaundiced during this time.

The operation on November 27 was performed under spinal anesthesia; supplemented by gas and ether anesthesia because the line of anesthesia was not sufficiently high. The error in diagnosis forced us to add the general anesthetic.

A midline incision above the symphysis was later extended to above the umbilicus. The abdomen was filled with tan colored milk-like fluid. The peritoneum was friable. Instead of being attached below, the cyst which had a hole one-half inch in diameter in it was attached to or arose from the liver by a broad 3 inch elongated base. The liver had many gray lines coursing over it and was soft and small. The cyst was adherent to the cystic duct and artery from which it was dissected. As the clamps to the liver were applied, the liver tissues were crushed, but the bleeding was controlled because the connective tissue and vessels of the liver were held by the clamps. A double row of clamps were applied and the cyst was removed below them, ligatures being applied as the clamps were removed. Although the wound was dry, as a matter of safety, iodoform gauze was packed against the liver and the abdominal wound closed, bringing the drain out through a stab wound in the right flank. The operative time was one hour and fifteen minutes. Following the operation the temperature and pulse rate rose, but the patient's condition was fair. Two days later

the patient became irrational but this cleared with the administration of abundant fluids.

The pulse then became slower and the temperature dropped gradually; the convalescence thereafter was uneventful, the patient going home on December 8, the eleventh postoperative day. The wound had healed by primary union.

The pathological report is:

"*Gross:* The specimen is a cyst wall from which the contents have been evacuated. A small piece of liver is attached at one side. The wall is three to six mm. thick, and the outer surface is smooth and mostly covered by a serous surface. The lining is smooth. When stuffed with cotton the cyst is 15 cm. in size and spherical in shape.

"*Microscopic:* The cyst wall is composed of a framework of dense fibrous tissue infiltrated with large numbers of small round cells and containing an abundant blood supply. Scattered throughout the wall there are many rudimentary liver lobules made up of more or less well formed cords. There are also a number of well formed bile ducts associated with arteries and veins, the veins being quite numerous, others forming slightly atypical glands of glisson. The lining of the cyst is a thin layer of dense fibrous connective tissue which acts as a very sharp limiting membrane resembling very much liver capsule, sending off branches to the imperfectly formed islands of glisson.

"*Diagnosis:* Unilocular cyst of the liver."

Two and one-half years later the patient has remained well.

I decided to report this case because I thought that liver cysts are rather rare, for few surgeons have had more than one case of liver cyst. Because it is impossible to number this case accurately I have decided to include it in a list numbering 499 reported cases which I have reviewed,* 187 of which are solitary, 20 solitary multilocular, 241 multiple, and 51 not stated. This list is arranged alphabetically instead of chronologically, and include in the bibliography all the books I have reviewed. I feel that there are many other cases on record, the reporting articles of which are not available to me.

* Table and bibliography included in report in *Grace Hospital Bulletin*, 20: No. 3 & 4 (July-Oct.) 1936.

In view of the large number of cases which I have found I feel justified in saying that liver cysts occur commonly though infrequently and are found in man, beast and fowl. The literature which I have reviewed has dealt extensively with the pathology and etiology of liver cysts, especially the articles by Herxheimer, Leppman, Konjetzke, and Moschowitz, but only scantily with the diagnosis. Because liver cysts have seldom been diagnosed before operation, I shall make an extra effort in discussing the diagnostic criteria. I shall give first, however, the etiological and pathological classifications and shall close by listing the operative procedures which have been used.

Some men believe that liver cysts are always a part of general cystic disease which, of course, would mean that there should be no solitary liver cysts; Bard and Lemoine, have stated that all the observations they could find indicated that cystic degeneration of the liver is always associated with cystic kidneys. Others believe that there are solitary cysts; Alexander believes that solitary cysts exist, and he thinks that they are etiologically different from the cysts in general cystic disease. Moschowitz, in 85 cases of liver cysts which he reported, found 10 cases which were not associated with cysts elsewhere. A study of the reported cases collected in my list suggests that the two types of cysts, single and multiple, do exist. Only 152 cases had kidney cysts.

I first intended to list solitary cysts only because the cyst in this case was solitary, but I found that such a list would not be accurate because of variations in the descriptions of cysts, some writers calling a certain cyst solitary and others calling the same cyst multiple. The reason for this divergence of classifications of the same cyst is that cysts occur not only as single solitary cysts but as tumor masses consisting of a solitary group of multiple cysts; a third group of cysts is the true multiple type in which the cysts are not grouped; and in addition to those which

occur in the liver, cysts may be found in the kidneys, spleen, pancreas, lungs, brain, pituitary gland, breasts, ovaries and peritoneum. When cysts occur in many organs, the condition constitutes general cystic disease. Accordingly, I have separated the solitary cysts into solitary and multilocular solitary and placed the scattered cysts only in the multiple group. My reason for linking multilocular solitary cysts with unilocular cysts is that unilocular cysts may be advanced multilocular cysts in which the walls separating the cysts in the multilocular variety have disappeared as a result of pressure, as evidenced by the trabecula generally found in the unilocular cysts.

Fig. 1. Gross appearance of liver cyst actual size 15 cm. in. diameter.

The following classification has been summarized from the literature:

1. Inflammatory group in which fibrous tissue about the ducts has caused obstruction of the ducts inducing biliary stasis and resulting in pseudocysts or retention cysts;

2. A degenerative group arising from atrophic tumors, as cystic adenomata, degenerated sarcoma, and carcinomas, the type of tumor indicating the etiology;

3. Cavernous biliary angiomata;

4. Developmental cysts arising from aberrant bile ducts in the fibrous tissue of the portal spaces; this is the most favored theory;

5. Teratomatous or embryomatous cysts, dermoid;

6. Lymphatic cysts;

7. Ciliated cysts which have been considered as indicating congenital etiology; 14 of these have been reported according to Konjetzke;

8. Congenital obstruction and fetal cholangitis;

9. Corset pressure causing superficial liver atrophy and cysts;

10. Cysts following local hemorrhage; traumatic;

11. Mucous cysts derived from the mucous glands which are found in the biliary passages owing to a degeneration of these structures.

Cysts appearing in many organs indicate congenital etiology; 4, 7 and 8 indicate

congenital origin. The remarkable family history of cysts cited by Brooks points strongly to a congenital etiology.

If cysts are congenital, one would expect to find symptoms of cysts early in life. When symptoms have appeared early, they have appeared very early, even during delivery large cysts having prevented birth of the child. Many patients, however, have not presented symptoms until late in life. It has been stated that these cysts begin in childhood even though they have not been found until old age. Although the symptoms of cases reported cannot be considered diagnostic, symptoms have been grouped occasionally, so that cysts should be suspected. According to the predominating symptoms of the cyst, I shall list five main groups of symptoms.

1. The liver and gall-bladder group, the symptoms of which simulate gall-bladder disease, such as pain in the epigastrium and right upper quadrant radiating to the back and shoulder, a tumor mass, jaundice, chills, fever, nausea, vomiting, gas, indigestion, eructation and distress after certain foods. Although these symptoms may be caused by pressure on the gall bladder and bile ducts, it has been stated by some that when gall-bladder symptoms have been present, they have been caused by gallstones. There have been various opinions about the pain which occurs in liver cysts. Alexander states that pain is rare and generally is associated with peritonitis; Moschowitz states that pain is caused by rapid growth. It has also been stated that pain results from hemorrhage into the cyst. Similarly, many conflicting views arise concerning jaundice. Alexander, Everidge, Burghard, Evans, and MacMunn have cited cases with jaundice, but Moschowitz has said that jaundice is always absent. In spite of many conflicting opinions, when gall-bladder symptoms have been present, liver cysts have been found even when no gallstones were present.

2. The kidney group in which cystic disease of the kidneys causes anemia, edema of the legs, dyspnea, and albumin and blood in the urine. In this group, of course, the findings of cystic kidneys should make one suspect accompanying liver cysts and think of general cystic disease.

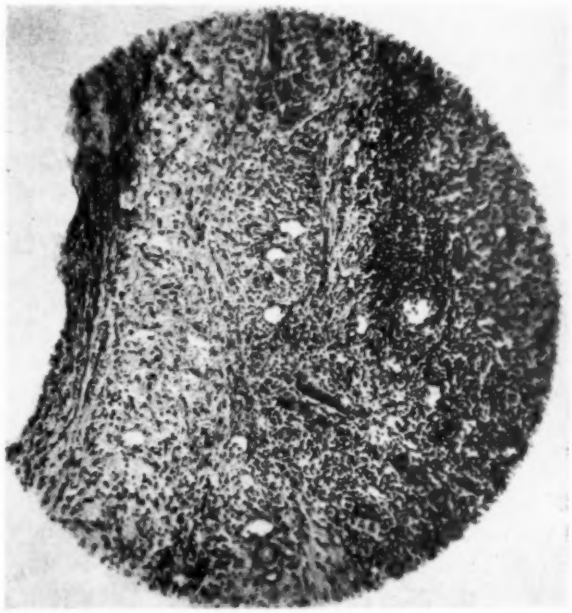

Fig. 2. Photomicrograph of cyst wall.

3. The pressure group in which symptoms arise from the organ where there is interference with its functions by pressure, such as stomach symptoms and blood in the stools. Symptoms of intestinal obstruction have also occurred.

4. The ruptured group in which the symptoms arise from the rupture of cysts. They arise from peritoneal irritation and consist chiefly of severe pain, collapse, fever and vomiting.

5. The ovarian cyst group because liver cysts frequently simulate ovarian cysts in physical signs.

When any of these groups of symptoms is accompanied by the physical findings of an ovarian cyst, which is the error in diagnosis most frequently made, liver cysts should be considered. Not only the dull fluctuating mass projecting in the middle of the abdomen with tympany in the flanks which indicates a cyst, but discrete nodular masses in the right upper quadrant should suggest liver cysts when accompanied by one of these various groups of symptoms.

Tympany in the hypogastrium instead of the epigastrium should be sought. The roentgen ray should offer good diagnostic aid. MacMunn states that the colon should be pushed down, but Beattie and Robertson who had their case *x*-rayed found the colon crowded up and the stomach and duodenum displaced to the left. The emptying time of the gall bladder was delayed.

I am indebted to Dr. Hans Jarre for the suggestion that the characteristic roentgenogram of a polycystic kidney should be a diagnostic and prognostic aid because so many liver cysts are accompanied by kidney cysts. If polycystic kidneys are present, liver cysts must be considered, but the prognosis cannot be so good as when the kidneys are normal. Jarre also suggested that the cyst be aspirated and the aspirated fluid replaced with one of the harmless intravenous dyes. Of course, when this can be done successfully, there can be no question about the diagnosis. Jarre believes that thorotrast should not be used until we have more proof that it is harmless, but when a body dye can be used, it will give great help in the diagnosis.

If aspiration can be done, one should be familiar with the characteristics of the fluid contained in liver cysts. The fluid obtained from these cysts has various qualities, as clear, serous, yellow or brown; it has been either thin or viscid, and has contained whitish mucoid flakes. Albumin has always been present; mucin, cholesterin, epithelium, red blood cells and granular cells have been found. Alexander states that bile has been found in some cysts, and Moschowitz states that bile and bile pigment are generally absent. The quantity of fluid has varied from a very small amount up to two and one-half gallons.

After the abdomen has been opened and a cyst unattached in the pelvis is found, a liver cyst should be suspected; and if found, familiarity with the technique of handling them will be useful. Various operations have been performed, as aspiration, opening and draining the cyst, marsupialization, evacuation of the cyst and sewing it up so as to obliterate the center without draining, as Bevan did. Other operations which have been done are partial excision of the cyst and drainage, complete excision of the cyst, and anastomosis of the cyst to the small bowel. All of these procedures have been tried successfully, and the mortality has been 50 deaths in 226 operations, a percentage of 22.12.

The surgeon, when operating, must remember two types of cysts, intra- and extra-hepatic. They may be pedunculated or not. Another point to be remembered is a differential given by McGannon between hydatid cysts and simple cysts. Hydatid cysts have laminated outer capsules and an inner membrane which carries the daughter cysts. Simple cysts have a thin single wall. When cysts have been excised, all methods for control of hemorrhage have been used with success, as blunt dissection with gauze, cautery excision, suture and excision, and excision and suture. I used the clamp method when I found that the connective tissue of the liver held the clamps, as the liver cells were crushed when the clamps were applied.

CONCLUSIONS

As nearly all other cases of liver cyst, this one was not diagnosed correctly; the symptoms belong to Groups 4 and 5, the patient never having suffered until the cyst ruptured. Excision was successful, the patient recovered, and the cyst was proved unilocular solitary both at operation and roentgenographically.

Note: I have checked some of the articles by abstracts. I am indebted to Dr. Hans Jarre for help in translating the French and German, Dr. J. C. Agins and Dr. Alex W. Sanders for the Russian, Dr. Hansen for the Swedish and Danish, and Dr. Boccia for the Italian; and to Dr. James E. Davis for other valuable aid.

FISTULAS AND CYSTS OF PANCREAS FOLLOWING OPERATIONS FOR HYPERINSULINISM

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IN a recent review of literature on hyperinsulinism, Whipple[8] reported the occurrence of pancreatic fistulas in 3 of 35 operative cases or 8.5 per cent. Two of these were in cases of hypoglycemia with island cell tumors and one was in a patient with hypoglycemia but without any evident tumor.

Allan, Boeck and Judd[1] in 1930, reported 2 cases of pancreatic fistula following partial resection of the pancreas in patients without pancreatic tumors. One of these cases was included in Whipple's review but the other was omitted. After resection, clamps had been left on the remnant of the body and according to these authors, a fistula developed in each case after the clamps were removed. The wounds, however, healed completely within several months without the necessity of further surgery. In a later report, 1933, Judd, Allan and Rynearson[4] mention 2 additional cases, one in a male patient, forty-five years of age, who developed a pancreatic fistula following the excision of a cystic tumor, 3 cm. in diameter, from the body of the pancreas. This fistula is said to have persisted for more than nine months before closing. The other case was that of a male patient, aged thirty-one years who was operated on in 1928 by Holman. No tumor was found then, and a partial pancreatectomy was performed. Subsequently a cyst developed and further surgical intervention was required before complete healing was obtained. This patient was operated upon again by Judd in 1933 and a small nodule of pancreas excised.

Womack, Gnagi and Graham[7] report a case of pancreatic fistula following the dissection of an adenoma which could not be shelled out, and a small margin of normal pancreatic tissue had to be excised with the tumor. A fistula developed but was reported to be healing rapidly at the time of dismissal from the hospital. An unpublished case of Fisher[3] of a pancreatic fistula and cyst requiring two subsequent incisions and drainage before healing could be secured, has also come to our attention.

The following is a report of a case of pancreatic fistula and cyst which developed following the removal of a small wedge of tissue from the body of the pancreas.

The patient, a single, white female, fifty years of age was admitted to St. Mary's Hospital on March 28, 1935, complaining of attacks characterized by loss of consciousness and generalized convulsions. She had had five major attacks since January 1, 1934, and at least one minor seizure daily. For the past three years she had complained of a vertigo. In 1930, she was in an automobile accident and suffered a depressed fracture of the skull just above the left ear, also a fractured clavicle and fractures of several of the bones of the right hand. In 1931, an operation was performed to relieve pressure symptoms over the right eye. With regard to her earlier medical history she stated that she had had cerebrospinal meningitis at the age of five years, bronchopneumonia at seventeen years and in 1915, a nephropexy on the right kidney. In 1925, she had a hysterectomy, a left oophorectomy, a partial right oophorectomy and appendectomy.

The physical examination was essentially negative. The heart sounds were distant and the rhythm somewhat irregular with an occasional dropped beat. The systolic blood pressure was 115 mm. Hg., and the diastolic blood pressure was 65 mm. of Hg. On laboratory examination the urinalysis was negative. The blood showed a hemoglobin of 84 per cent, leucocytes 9600

and erythrocytes 4,880,000. The Schilling differential count was normal. The non-protein nitrogen was 29 mg. per 100 c.c. blood serum.

Fig. 1. Anteriorposterior roentgen photograph with the patient lying on her back. The size, shape and position of the fistulous tract and the two cysts are shown. The large shadow at the bottom of the picture is the barrel of the syringe which was held in place to mark the site of the cutaneous opening.

Fig. 2. Lateral roentgen photograph with the patient lying on her back. The relationships of the fistulous tract and cyst to the adjacent structures are shown. The gas bubble in the stomach lies anteriorly and those of the colon lie inferiorly. The filling defect noted at the bottom of the larger cyst may be the body of the pancreas. The communicating tracts are clearly seen. The syringe marks the cutaneous opening.

The basal metabolic rate was plus 2 per cent. The sugar tolerance showed a low flat type of curve. The minimum blood sugar was 66 mgms. per 100 c.c. blood serum. A presumptive diagnosis of hyperinsulinism was made and on May 22, 1935 the abdomen was explored. The adhesions from her former operations were so numerous that examination was directed toward the pancreas without further delay. The tail of the pancreas could not be mobilized or adequately visualized because of its position, it being much further to the left than any I had previously encountered. The tip of the tail was attached by a vascular pedicle high up under the left costal margin. To liberate it without more adequate exposure, which could not be obtained, seemed too dangerous, as a hemorrhage from this source had nearly proved fatal in a previous operation on another patient. Accordingly, a wedge of tissue which had been devitalized and traumatized by the holding forcep was resected and the abdomen closed with drainage.

Pathologist's Report. The sections showed a moderate degree of fatty infiltration which is chiefly intralobular. There is some variation in the size of the acini, some being atrophic. The islet tissue was in rather large collections and was somewhat hyperplastic. It was not vacuolated, fibrous or hyalinized. The hemorrhage seen was likely operative.

The immediate course after operation was uneventful except that there was an abundant discharge of pure (inactive) pancreatic juice from the drainage tract. The amount was difficult to estimate accurately but approximated at least 300 to 400 c.c. daily. Applications of plain boric ointment to the skin about the tract gave satisfactory protection. At various times small samples of the discharge were collected and examined. The material was

alkaline in reaction and contained all three pancreatic enzymes.

On June 24 she was discharged from the hospital. The drainage which was clear and odorless, had diminished to some extent but was still sufficient to require a change of dressings about four times daily. The temperature was normal and the patient was able to be up and about. There was no pain or discomfort in the wound. The Wohlgemuth regimen for encouraging closure of the pancreatic fistula, by attempting to inhibit secretion, was adopted and she was given a diet high in carbohydrates and in alkaline foods, also large doses of soda bicarbonate and belladonna. The drainage diminished to a considerable extent and the patient returned to her home in a nearby city. Five days later she came under our care again complaining of a severe pressure-type of pain under the left costal margin, nausea and weakness. Her temperature was 100.8. F. The fistula was aspirated with a small flexible silver cannula and 120 c.c. of thick yellowish fluid was obtained. This was examined microscopically and found to contain large numbers of leucocytes. On bacteriological examination the organisms were identified as Staphylococcus albus hemolyticus. Daily aspiration was continued as it seemed possible to completely empty the fistulous pocket in this manner. At the same time she was given deep roentgen ray treatments in an attempt to inhibit pancreatic secretion. A current of 200 kilowatts and 5 milliamperes was administered to the left upper quadrant of the abdomen for fifteen minutes at a sitting, receiving a total exposure of seventy-five minutes. After two weeks' time there was no apparent improvement. The temperature varied from 99.4 to 101.2 F. The character of the drainage remained unaltered and from 80 to 100 c.c. could be aspirated daily. The patient still complained of discomfort in the left upper abdomen and began to assume the appearance of chronic sepsis. Accordingly, on July 28, 1935, the fistula was injected with 20 c.c. of iodochloral and anteroposterior and lateral *x*-ray pictures revealed two pockets, a smaller one superimposed over a much larger one which lay deep within the lesser omental sac and was bounded by the posterior parietal wall behind, the stomach superiorly, the colon and transverse mesocolon inferiorly and the gastrocolic omentum anteriorly. It appeared to drain by a tortuous tract into the upper smaller pocket, which in turn, communicated with the skin (Figs. 1 and 2). The patient returned to the hospital July 30, 1935, and the cysts were drained surgically. The dissection of the tract was made entirely extraperitoneally and about 600 c.c. of purulent pancreatic fluid containing much necrotic material was evacuated. A large rubber tissue cigarette drain was inserted to the bottom of the larger cyst. The patient improved promptly. The temperature returned to normal and there was complete relief of pain. She was discharged August 8 and was able to be up and about. The quantity of discharge gradually diminished and successively smaller drains were introduced every few days. The patient showed a progressive gain in weight and strength. The capacity of the tract was measured from time to time, and by September 17, it had diminished to 2 c.c. There had been no drainage for three weeks. The drain tube was removed entirely and the tract allowed to heal. She returned home October 9, 1935, and has remained entirely well since, except for a persistence of the major hypoglycemic convulsions.

DISCUSSION

The excision of pancreatic tumors by the removal of a surrounding wedge of normal tissue appears to be a more likely cause of fistula than does partial pancreatic resection. In the latter case the pancreas is divided transversely and the distal portion is removed, as in 6 patients of my own in which amounts of pancreatic tissue varying from 8 gm. to 40 gm. were removed without the subsequent development of fistulas. One should expect very little retrograde leakage of pancreatic juice in partial pancreatectomies because the secretion pressure constantly tends to propel the fluid toward the duodenum. Furthermore, Korovitsky[5] showed that the pancreatic ducts possessed a definite tonus, which by means of alternate relaxations and contractions play an active role in conducting the pancreatic juice toward the duodenum and were not, as some supposed, merely passive conducting tubes.

The technical methods employed in dividing the pancreas and in closing the stump, that is, whether by scalpel, with

hemostatic control either by suture or by forcipressure with clamps, or whether by actual cautery or surgical diathermy, is not important.[6] Fistulas should heal most readily when the main duct has not been injured and where there is no stenosis or occlusion of the duct proximally.

The reason for the development of a cyst in this particular case is not entirely clear. The tract was never wholly blocked for any considerable period of time. The quantity of drainage simply diminished gradually and it was supposed that the fistula was contracting down in the healing process until the patient suddenly complained of pain and discomfort. Furthermore, after six weeks the juice became infected despite the care taken to prevent this complication. The associated stasis and considerable degree of retention of pancreatic juice was undoubtedly a significant factor. This feature we believe has not received sufficient emphasis in the literature and we feel certain that infections occur more frequently than reported. Experimental observation in total pancreatic fistulas in dogs have shown that the most scrupulous aseptic procedures are necessary to maintain sterility of the pancreatic juice and that failure to secure perfect asepsis are common.[2] In human pancreatic fistulas the source of infection is, no doubt, the bacteria derived from the skin about the cutaneous opening of the fistulous tract. Contamination from this source appears unavoidable. If the fistula does not close spontaneously while adequate drainage is being provided its implantion into the gastrointestinal tract must be attempted. In our hands deep roentgen ray therapy failed to produce any demonstrable inhibition of pancreatic secretion.

CONCLUSION

Pancreatic fistulas are more likely to follow the local excision of adenomata than the complete resection of more considerable amounts of gland tissue by transverse division and removal of the distal portion or subtotal pancreatectomy. Infection of pancreatic juice from a fistula is probably not uncommon whenever stasis of the secretion occurs. This apparently causes no immediate serious sequels unless complete retention of the pancreatic juice also takes place. The treatment of pancreatic fistulas should be at first conservative but surgical intervention should be instituted promptly whenever it is evident that conservative measures have failed.

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PHLEGMONOUS GASTRITIS*

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INTEREST in an unusual suppurative lesion of the upper gastrointestinal tract has been revived in the past decade by the reports of Watson,[1] Gerster[2] and Martland and Eisenberg.[3] Diffuse suppurative inflammation of the stomach is by no means rare. It has been reported in the seventeenth century by Varandalus, 1620, Borel, 1656, Bonet and Sand, 1656–1701.[4]

Phlegmonous gastritis is a suppurating lesion of the stomach involving chiefly the submucosa. This layer of the gastric wall is markedly thickened and when cut, shows a purulent material. All the cases in the literature have been autopsy reports. It is conceivable that milder cases, undiagnosed, have recovered with extreme fibrosis, as the end result. Is the healed case the forerunner of linitis plastica (chronic cirrhotic gastritis) where the sclerosing process is found mainly in the submucosa? Kaufman[5] states that in rare instances a diffuse phlegmon may heal leaving a cicatricial submucosa. The mode of drainage is by perforation through the mucosa.

Gerster[2] collected over 215 cases, of which 85 per cent were phlegmonous and all but 27 of these were of the diffuse variety. He divided the cases into abscess and phelgmon; the later into diffuse and circumscribed. Only in the circumscribed phlegmon group were subacute and chronic cases noted. The lesion involves all age groups from twenty to sixty years. The various etiologic organisms noted are streptococcus in 70 per cent of the cases, staphylococcus, pneumococcus, Bacterium coli and Bacillus subtilis. While most of the cases have been unassociated with other lesions, an occasional case has been noted after trauma to the abdomen, peptic ulcer or with carcinoma of the stomach. Martland[3] quotes an epidemic of puerperal sepsis in 1847 in Prague that showed a number of cases. Exanthemata and sepsis have been frequently followed by phlegmonous gastritis. MacCallum reported 2 cases in which the phlegmonous lesion involved portions of the small gut. Graves[6] reported 2 cases from Hongkong.

In all cases demonstrating the diffuse lesion, the localization of the lesion to the submucosa has been noted. This led Leith[3] to note a parallel between this lesion and the cutaneous forms of erysipelas. Virchow is said to have spoken of phlegmonous gastritis as a carbuncle of the stomach. The suggestion of Leith has been further substantiated in the case of Martland and Eisenberg[3] where further studies on the offending organism by Birkhaug showed its relationship to the streptococcus of erysipelas. In our case, the streptococcus was also a hemolyzing type.

The peritoneal involvement is caused by direct extension through the wall of the stomach. This is amply illustrated by the cases of Pritchard and Roberts.[7]

CASE REPORT

J. A., aged twenty-six years, male, white, laborer was admitted to the Coney Island Hospital on February 24, 1933 complaining of severe abdominal pain. This had begun suddenly two days prior to admission as an agonizing pain in the left upper quadrant. He vomited a number of times. He was unable to leave his bed. His bowels were constipated but the patient did not take a cathartic. He had been taking bicarbonate of soda for several years for indigestion. Examination showed an acutely ill young, adult male, temperature 104.6, pulse rapid, blood pressure 104/64. His lips, mouth and throat were negative, but the nasal mucous membrane was congested.

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The heart and lungs were essentially negative. His entire abdomen was rigid and moderately distended with exquisite tenderness in the epigastrium and the left upper quadrant. Liver dullness appeared diminished. The patient hiccoughed frequently. The preoperative diagnosis was perforated ulcer.

Fig. 1. Stomach (3/8 ×) cut open. Note marked thickening of wall, serosal exudate and puffy mucosa.

Operation was performed shortly after admission but no perforation of the stomach or duodenum was found, but a plastic exudate was noted covering the stomach and pylorus. The omentum was drawn up over the pyloric region. There was a general peritonitis. The stomach was markedly distended throughout and thick walled. The abdomen was closed with drainage. Death took place twenty-four hours after admission.

Necropsy performed three hours after death showed the body of a well developed and well nourished young adult male. There was no escharation of the lips or buccal mucous membrane.

The pleural cavities contained no fluid. The upper lobes of both lungs were adherent to the lateral and posterior chest walls. The trachea and bronchi were smooth and contained a moderate amount of pink, frothy fluid. The right upper lobe was irregularly retracted, on section, showing innumerable small groups of pearly-grey spherical nodules about the size of a millet seed. There was no area of caseation or cavity formation. The remaining lobes showed intense congestion and edema. Microscopic study of sections of the right upper lobe showed innumerable tubercles, many of which were confluent. There was a moderate fibrosis. Sections taken from other lobes, showed intense congestion and exudation of fibrin and red blood cells into the alveoli.

The heart weighed 305 grams. The pericardium was smooth and glistening. The cavity contained no free fluid. Several petechial hemorrhages were noted along the posterior auriculoventricular groove. There was no obstruction to any of the valve orifices. All valve leaflets showed an average appearance. The interauricular and interventricular septi were intact. The myocardium on section was brick red in color. The coronary tree was smooth walled throughout. The scar of the ductus arteriosus was marked in both the aorta and the pulmonary artery. Microscopy showed an intact myocardium.

The liver weighed 1730 grams. Glisson's capsule was smooth. On section the parenchyma had a parboiled appearance, through which confluent pale yellow areas were noted. The biliary tract was average in appearance throughout. The portal and superior mesenteric veins were intact. Microscopic study showed fatty degeneration of the hepatic cells. About the central portions of the lobule there was marked congestion. The liver cells showed cloudy swelling throughout.

The spleen weighed 180 grams, was slate blue in color. The capsule was wrinkled. The organ on section was pultaceous in consistency,

Gastrointestinal Tract. The esophagus was smooth walled throughout showing no ulcerations, escharation, tumefaction or diverticulum.

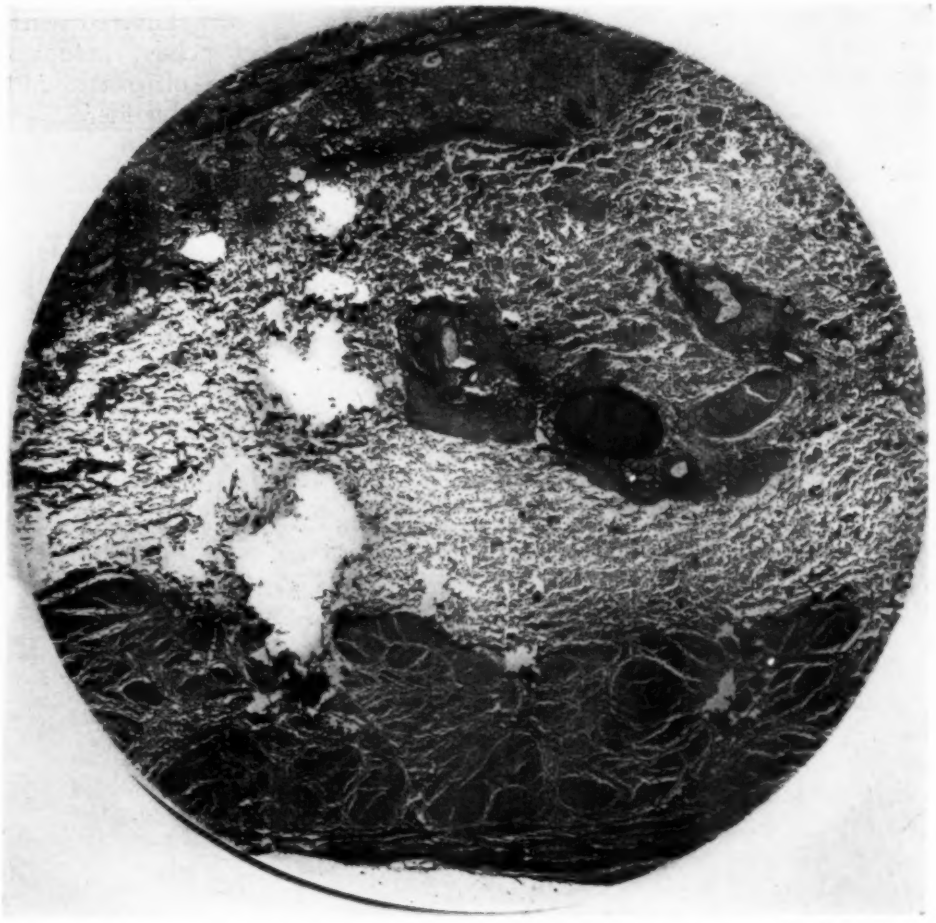

Fig. 2. Low power (15×) of stomach wall showing marked widening of submucosa and extension through muscularis and involvement of serosa.

and the usual markings could not be recognized. At the hilum there was an accessory spleen measuring 0.7 cm in diameter, which was also soft in consistency. The splenic artery and vein were of average appearance. Sections of the spleen showed extreme engorgement and loss of follicular structure.

The pancreas and adrenals showed no changes.

Urogenital Tract. The kidneys weighed 210 grams each. The capsules stripped with ease. On section, the organs were purplish red in color, and the cortex well demarcated and of average width. Microscopy showed only marked engorgement of all the vessels. The pelves, ureters and bladder showed no changes. Prostate was small and firm. On section it was of average appearance.

The stomach weighed 690 grams, was moderately distended and filled the entire upper half of the abdomen. There was a plastic exudate over the serosal surface, more especially marked at the pylorus. When opened, the wall was found thickened, measuring 0.8 cm., with a purulent fluid oozing from its cut section. This process began abruptly at the cardia and ended equally sharply at the pyloric ring. The mucosa was markedly puffed; at the gastric side of the pylorus were found two irregularly circular areas measuring 2 cm. and 1 cm. respectively, covered with a green tinged fibrin, which when lifted off showed a superficial red ulceration. The cut aspect of the wall was roughly divided into three layers; an inner pink-red and an outer grey layer, and between these there was a layer of frank suppuration

which exuded a thick, creamy, greenish pus. Cultures of this showed a hemolyzing, short chained streptococcus in pure culture. The organism was bile resistent. Along the lesser curvature in the gastrohepatic ligament and along the greater curvature were found many small lymph nodes which on section were grey in color, soft in consistency and moist.

The remainder of the small gut, the colon and appendix were intact.

Microscopic sections of the stomach wall showed that the mucosa was edematous. The structure of the glands were indistinct in the superficial layers. However, in the deeper regions the fundi were prominent. There was a moderately diffuse infiltration of the mucosa with lymphocytes and an occasional polymorphonuclear leucocyte which tended to become focal just above the muscularis mucosa; however, the lymphocytes predominated. The muscularis mucosa was frayed and throughout its length showed a diffused polymorphonuclear leucocytic infiltrate. The submucosa was enormously thickened, being approximately four times the depth of the mucosa. Several large blood vessels filled with red cells were present. There were several areas of extravascular blood. A number of small thrombosed vessels were noted, the walls of which were infiltrated with polymorphonuclear leucocytes. Throughout the submucosa there was a widespread, intense inflammatory reaction consisting almost entirely of polymorphonuclear leucocytes with an occasional lymphocyte. There was complete necrosis of all underlying structures as shown by bands of structureless acidophilic tissue. The various bands of muscle fibers were separated by sheets of polymorphonuclear leucocytes extending downward from the submucosa. The serosa was markedly engorged and infiltrated with polymorphonuclear leucocytes and was covered with a layer of purulent fibrin.

The peritoneum was markedly injected throughout. The serous coat of many loops of the small gut was covered with a plastic exudate. In the pelvis there was found a localized collection of pus bounded by the posterior wall of the bladder and the anterior wall of the rectum. This pocket contained about 30 c.c. of pus. The culture showed Steptococcus hemolyticus.

Anatomic Diagnosis. Phlegmonous gastritis; diffuse peritonitis; localized peritonitis (pelvic abscess); adhesive pleuritis, bilateral; miliary tuberculosis, right upper lobe; cloudy swelling of the liver; infectious splenomegaly.

SUMMARY

A case of diffuse phlegmonous gastritis is presented. The organism was a hemolyzing streptococcus.

A review of the literature is given with especial reference to the similarity of the lesion to erysipelas infections.

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TRICHOBEZOAR AND PHYTOBEZOAR*

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THE term bezoar is of Persian origin and in early times was applied to concretions of various types found in the stomach or intestines of animals. Such bezoars were highly prized as popular medical remedies in the Middle Ages. They are mentioned in early Persian manuscripts and in Hindu literature in the twelfth century by Susruta. In later times the term bezoar has been retained but has been modified. Trichobezoar is applied to a concretion the matrix of which is human or animal hair, commonly known as hair balls, and is often found in hairy animals such as the cow, cat, etc. This is the type also commonly found in humans. Phytobezoar is the name applied to concrements the basis of which is composed of seeds or other parts of plants.

In 1779, Baudamant[1] described the first case of a trichobezoar observed in man. Schoenborn reported the first operation for hair ball in a human subject in 1883. According to Kerr and Rypius[2] 139 cases of bezoars in humans were reported in the literature up to 1930 and a few cases since then. The most important modern contributions to the literature of this subject have been made by Matas,[3] Davies,[4] Hart[5] and Maes.[6]

Phytobezoars have been much less commonly observed in human subjects than trichobezoars. Of the 139 cases collected by Kerr and Rypius only 20 were phytobezoars; Maes increased this total to 23. In animals a mixed type, the trichophytobezoar, has been observed but, so far as we can find, no concretion of this type has been reported in a human subject.

Hair balls may occur as multiple or single masses. In the stomach the mass is usually single and in time forms a kind of cast of the viscus. The masses may be multiple in the small intestine but occur far less frequently than in the stomach. In the human subject the size varies; in Davies'[4] case of trichobezoar, the mass weighed 6½ pounds, the largest on record.

Regarding etiology, the only definite cause is the hair eating or swallowing habit which may be deliberate or occupational; in one case the patient was a wig maker for many years and probably accidentally swallowed much small hair floating about or which was held in the mouth in the course of work. Most cases, however, of trichobezoar are observed in nervous young girls who formed the habit of chewing or biting the hair. This accounts for the greater frequency of the condition in females than in males, the longer hair of the former facilitating the habit. Maes found only 2 cases in males reported in the literature up to 1928. Faulkner and Adams[7] reported a case in 1933, observed in a man aged thirty-one years. Kerr and Rypius[2] in the same year reported a case in a male of twenty-seven years.

The clinical symptoms in the case of a trichobezoar or phytobezoar depend upon the position, size and development of inflammatory or other phenomena. In the advanced stage the objective signs are always those of an acute gastric disturbance and may suggest a malignant condition; pain, vomiting, diarrhea with alternating constipation, foul breath, offensive stools, emaciation, inanition and perhaps, in the final stages, intestinal obstruction may be noted. However, in the ordinary case before the final stages the most striking feature of the syndrome is that in spite of

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the persistence and severity of the symptoms the patient generally has the appearance of good health.

When trichobezoar or phytobezoar is definitely diagnosed the only efficient treatment is surgical operation. Any medica-

Fig. 1. Phytobezoars in stomach distended nearly full with barium.

Fig. 2. Outline of phytobezoars six hours after ingestion of barium meal.

Diagnosis up to the advent of roentgen-ray investigation was usually very difficult. In 47 cases collected by Matas[3] a correct preoperative diagnosis was only made in 10. Holland,[8] in 1913, was the first to describe the roentgenographic appearance of trichobezoar of the stomach. At present with this method of observation it is almost impossible to miss the condition as the radiologic findings are constant and definite. It is seen that the mass lies free in the gastric cavity where it is observed as a shadow or as a lighter area amid the darker area of the opaque barium which outlines and coats it. Under the fluoroscope it can be made to change its position freely on palpation.

The efficiency of the radiological method of investigation in this pathologic condition explains the increasing number of bezoar cases reported as correctly diagnosed clinically within recent years.

mental agent strong enough to affect the mass is likely first to injure or destroy the gastric mucosa. The stomach should be opened anteriorly by an incision large enough to allow removal of the concretion. As a rule, the wound can be closed without drainage. But before closure the surgeon should explore the vicinity for the possible presence of other bezoars.

In the 47 cases collected by Matas up to 1914, he found that the operative mortality was 4.7 per cent, but with more modern surgical methods this should be reduced considerably. It should be pointed out that, occasionally, these concretions recur. Le Wald[9] and Matas[3] reported cases in which during a period of years the patients were reoperated several times for hair balls. Such a recurrence is more likely to be found in psychotic patients having an uncontrollable habit of biting

hair and swallowing it. Bennett[10] recently reported a case of recurrent hair ball in the stomach.

Fig. 3. Phytobezoars immediately after removal from stomach.

CASE REPORT

The patient, a female, aged fifty-four years, presented herself on December 14, 1935, with a history of constipation, nausea and vomiting of six weeks duration, and abdominal pains of one week duration. The patient states that she had been suffering from chronic constipation for many years which was unrelieved by medication but remedied by daily enemas. Aside from this she has been feeling quite well until six weeks prior to entrance into the hospital. While attending a lecture she became suddenly nauseated. She tried to vomit but could not; however, retching relieved her.

At that particular time there were no other complaints and the patient felt quite well by bedtime of the same evening. On the following two days she complained of malaise and noticed that the returns from her enema were of a very dark color. For about two days the stools were "black."

At the time these stools were noticed she started to vomit and has vomited almost daily for the past six weeks. The first vomitus consisted of sour, brown material which contained undigested food particles recently eaten. Lately the vomitus has been bitter and green, and vomiting came on one to three hours after eating.

Believing that the intake of food caused the vomiting the patient abstained from solids. This was soon followed by anorexia and a loss of twenty-five pounds in the ensuing month. There was no pain until five or six days prior to entrance into the hospital when the patient noticed cramplike sensations, at first on the left side and then in the right upper quadrant. Vomiting increased until nothing taken by mouth could be retained. The past few days she has partaken of broth only. Though not confined to her bed, the patient felt weak and unable to work.

Past History. She had the usual childhood diseases; otherwise irrelevant; menopause ten years ago.

In going over the patient's past history, she stated that five years ago she began to regulate her own diet so that she could obtain fresher foods and thereby keep her bowels regular. Her diet consisted of fresh fruits, milk, cereals and whole wheat bread. The only meat she ate was a small amount of bacon and occasionally a piece of liver because she believed she could not digest meats well. She ate all vegetables.

After an unusual appearing radiograph the patient was interrogated as to the intake of foreign bodies, hair or unusual foods. It was in the course of this questioning that we learned that she was very fond of persimmons and has eaten them for over a period of five years. Ten days prior to her "attack" in a lecture

hall, she bought a basket full of small persimmons, possibly unripe, and ate about twelve of these in the course of the evening.

On sectioning, the persimmon balls presented an orange-yellow color characteristic of persimmons. They contained seeds within them and many vegetable and plant fibres. They measured 6 by 4.8 by 4.7 cm and 5.6 by 4.7 by 4.5 cm respectively and weighed 61.5 and 54.2 grams respectively. (Figs. 3 and 4.)

FIG. 4. Phytobezoars sectioned.

Physical Examination. There was slight palpitation and dyspnea and slight tremor of the head.

Gastric analysis showed 37° total acid, 19° free HCl, and 18° combined; no lactic acid was present. It was negative for occult blood. Microscopically, many yeast and few starch granules were present.

The urine was dark at the onset of the present illness, otherwise negative.

The blood picture showed hemoglobin 80 per cent, coagulation 3 minutes, erythrocytes 4,300,000, leucocytes 5600, with a differential count of 12 per cent small lymphocytes, 6 per cent large lymphocytes, 3 per cent transitional, 78 per cent neutrophiles, and 1 per cent eosinophile.

The Wassermann and Kahn reactions were negative.

Fluoroscopy revealed a filling defect in the stomach; peristalsis was good. A normal duodenal bulb was visualized; the gastric rugae were normal. Two shadows rather widely separated appeared as foreign bodies in the stomach. A six-hour plate revealed these masses coated with barium, lying free in the stomach. (Figs. 1 and 2.)

A preoperative diagnosis of phytobezoar was made and surgery advised. The patient was operated on December 20, 1935. A right upper transrectus incision was made and a gastrotomy was performed. Two large soft, emerald-green stained foreign bodies were removed. The stomach was closed by a two layer suture line. Nitrous oxide anesthesia was used throughout.

The postoperative course was uneventful. The patient was discharged from the hospital on the twelfth postoperative day. At present the patient is eating a regular, unselected diet, gaining in weight and feeling well.

SUMMARY

1. A case of phytobezoar diagnosed preoperatively is reported.

2. The importance of careful history taking, particularly of ingestion of substances tending to form bezoars is stressed.

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INTESTINAL OBSTRUCTION DUE TO NON-SPECIFIC ILEOCECAL GRANULOMA*

(COMBINED "REGIONAL ILEITIS" AND COLITIS)

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BECAUSE these cases are rare, the usually described pathology is ordinarily limited to the terminal ileum. The cause is usually entirely unknown, although recently Felsen alleged that many of these cases are an appendicular form of bacillary dysentery, an interesting suggestion as yet not fully acknowledged and, finally, because the usually recommended surgical procedure consists of an intestinal resection, it has been deemed worth while to report this case, inasmuch as exactly opposite conditions prevailed, and the patient made a prompt and complete recovery. In my case, (1) the cause was definitely known, viz: secondary infection due to slight trauma to the ileocecal region in course of "Robbin operation" for adherent retrocecal appendix, through a small gridiron incision; (2) extensive pathology developed within ten days, involving the ileocecal region which was entirely normal at time of appendectomy; (3) the pathologic process involved the cecum and ascending colon as well as the terminal ileum; (4) ileostomy, which has not been previously recommended for this condition, effected a prompt and, apparently, a lasting cure.

CASE REPORT

R. R. T., male, aged thirty-three years, white, meat cutter, was admitted November 26, 1935, complaining of crampy pains in left lower abdomen for the past two days, with diarrhea and difficulty in passing flatus.

Family History. One sister died last year of pulmonary tuberculosis.

Past History. On September 26, 1934, the patient's face was operated upon for removal of what was thought to be an infected sebaceous cyst. Pathological report was, "Sections show the structure of lymphoid tissue with many characteristic tubercles. Diagnosis: Tuberculous lymphadenitis."

The patient was admitted on November 13, 1935, and discharged improved on November 21, 1935, with history of repeated attacks of crampy pain over McBurney's point, the last attack occurring the day prior to admission. Appendectomy was done through a gridiron incision and a difficult retrocecal appendix was removed by the Robbin method. The cecum was difficult to mobilize so that more than the usual amount of operative trauma occurred to the ileocecal region in removing the appendix. Pathological report was "early appendicitis." The patient was symptomless and apparently well on date of discharge.

Interval History. The patient left the hospital, well, five days ago, but two nights ago, i.e., on November 24, 1935, he began to have crampy pains in the left lower abdomen. The pains persisted, without nausea or vomiting, but he was able to pass his flatus with difficulty and he had two small diarrheal stools. He attributed this, at first, to dietery indiscretion, eating raw cabbage, etc. On day of admission, the pains became more severe, bowel movement was very slight, and he was able to pass only a small amount of flatus. He then called his physician and was hospitalized with tentative diagnosis of partial intestinal obstruction.

Physical Examination. Essentially negative; no abdominal spasm; no rigidity; only slight tenderness in left lower quadrant; no visible peristalsis; no masses detected. Rectal examination was entirely negative.

Laboratory Findings. November 26, 1935, Non-protein nitrogen 35 mgm. November 27, leucocytes 7900. Non-protein nitrogen 29; chlorides 445. November 29, non-protein nitrogen 35; chlorides 445. December 2, non-protein nitrogen 30; chlorides 412. December 4, non-protein nitrogen 41; chlorides 420, leucocytes 10,600.

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X-ray films reported by Lingeman November 26, 1935, "Small bowel dilatation in the left upper quadrant."

Twelve hours later a film "shows considerable extension of the dilitation of the small bowel."

Dec. 1, 1935. "The evidence is strongly in favor of small bowel obstruction."

Jan. 13, 1936. Entirely negative G.I. series. "Barium enema shows normal colon including region of cecum."

Operative Findings. A large, thickened, apparently inflammatory mass was found involving the last 8 inches of terminal ileum, the cecum and about 4 inches of the ascending colon. The mesentery of the terminal ileum was greatly thickened and hyperplastic, perhaps one inch or more thick. The terminal ileum seemed to be plastered down rather firmly to the posterior parietal peritoneum; likewise for the cecum and lower part of the ascending colon. The normal sheen was gone and the peritoneum was hyperemic. Proximal to the bound down hyperplastic terminal ileum, the bowel was "water-logged" for about 2 or 3 feet, edematous, and cyanotic, with lymphatic stasis, due to the obstruction. No tubercles could be seen anywhere, yet, in the gross, it looked like a typical tuberculosis of the cecum, or, failing that, a carcinoma of the cecum. A simple ileostomy was done.

CONCLUSIONS

This is an interesting case because it is

1. Rarer than strict "terminal or regional ileitis," because in this case the cecum and ascending colon were likewise involved. In a total of 60 recorded cases, to date, of "regional ileitis," in only 9, not counting this case, was the "combined form" present, that is, with involvement of the cecum and the colon in the same pathologic process.

2. Radiographic studies proved more valuable than all other laboratory tests for diagnostic purposes. When *x*-ray pictures are positive, and show partial intestinal obstruction, operation should not be delayed even if blood chemistry and other laboratory tests are normal or show only slight changes.

3. Tuberculosis in family; his sister had died of pulmonary tuberculosis and the patient himself had a tuberculous skin lesion on his face and tuberculous adenitis, proved by microscopical examination of biopsy specimen. Because of this history of tuberculosis, doctors who witnessed the operation thought the case was one of tuberculosis of cecum, involving the terminal ileum, and hence they suggested doing an intestinal resection and performing an ileotransverse colostomy.

4. Tuberculosis and carcinoma were both ruled out solely on the basis of the short duration, because less than two weeks before, at the time that I performed the appendectomy, I distinctly remembered that the ileocecal region was normal, except for an adherent, retrocecal appendix with the cecum only slightly movable. No masses whatever were present. Nothing suggesting the ileocecal granuloma was visible then.

5. Cured by simple ileostomy, just proximal to the dilated, obstructed ileum, the relief was so prompt and the cure so satisfactory, and the operative mortality in this procedure so low, as to warrant suggesting that it be tried in more "early" cases of this type.

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BRAIN ABSCESS; HEART BLOCK; SYPHILIS*

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THIS case of an acute subcortical brain abscess of otitic origin in the left temporosphenoidal lobe, is reported because of an evident cure obtained by the institution of a simple surgical procedure done despite the grave co-existing complications of heart block and syphilis.

H. W., a married female, twenty-five years of age, was admitted to the Greenpoint Hospital, March 3, 1936, complaining of a generalized headache and discharging left ear.

Past History. She had had measles during childhood. There had been one miscarriage at two months and one child had died at the age of five and one-half years. She used alcohol and tobacco in moderation. The history relative to her left ear was very indefinite and unsatisfactory, but she recalled having had some trouble beginning at the age of fifteen years but could not describe the character; she also believes she had some trouble three months prior to admission to the hospital.

Present illness began one week before her admission with pain in her left ear and two days before admission it discharged a little. She had a generalized headache and had vomited twice.

Physical examination revealed an apathetic drowsy individual, fairly well nourished, responding poorly to questions. There was a questionable facial weakness of the right lower half and the tongue deviated to the right. The pupils were equal and reacted to light and accommodation. There was some weakness of right hand and a questionable adiadochocinesis. All abdominal reflexes were absent; the knee jerk was diminished on the right but there was no ankle clonus, Babinski or neck rigidity. A small nystagmus on looking to the right and to the left was present. The right eye showed a beginning papilledema; the left eye was normal. There was no past pointing. Some swelling of the right buccal region and pyorrhea alveolarus were evident. The nasal cavities contained some free pus. The right ear drum was intact but was retracted anteriorly, with a calcified area and scar in the posterior aspect. Left ear had a foul pulsating discharge, showed an otitis externa. The drum could not be visualized entirely. No cholesteatoma was seen but there was a question of a dehiscence in the anterior superior quadrant of the drum. Hearing apparently was good on both sides. A normal response was obtained when the left ear was douched with ether.

The *lungs* were clear. Systolic and presystolic murmurs were heard at the apex of the heart. The *pulse rate* was 32 beats per minute; *temperature* 99.2 F., and respiratory rate 20. Clear *spinal* fluid was obtained under marked pressure and the cell count showed 18 lymphocytes. The blood count revealed 5,050,000 erythrocytes with 90 per cent hemoglobin; 23,500 leucocytes with 94 per cent polymorphonuclear and 6 per cent lymphocytes.

Roentgenogram of the paranasal sinuses showed slight cloudiness of the right frontal sinus. The right mastoid was sclerotic; the left mastoid was impossible to examine but no fracture was demonstrable. There was no suggestion of increased intracerebral pressure. The sella turcica fossa was of medium size and showed no abnormality.

One hour after admission an electrocardiogram showed an auricular rate of 50 and a ventricular rate of 30. The main finding in all four leads was a complete dissociation of the auricle from the ventricle.

Examination. On March 5 all symptoms became more marked. The left pupil was dilated and the right appeared contracted; double choked disc but greater on the left. There was marked stupor and apathy; the patient could not raise her right arm or hold it up in position. Her temperature was 99.6 F., pulse rate 28 and blood pressure 150/80. The

* Presented at the Otolaryngological Section, Kings County Medical Society and to the Staff Conference at the Greenpoint Hospital, May 21, 1936. From the Otolaryngological Service of Greenpoint Hospital, Brooklyn.

spinal tap about 50/60 c.c. of a clear fluid was obtained under pressure; count showed 30 cells; globulin 3; Kline test positive; sugar to the skin. Another catheter was placed within the outside dressing for daily irrigation with Dakin's solution. Additional treatment insti-

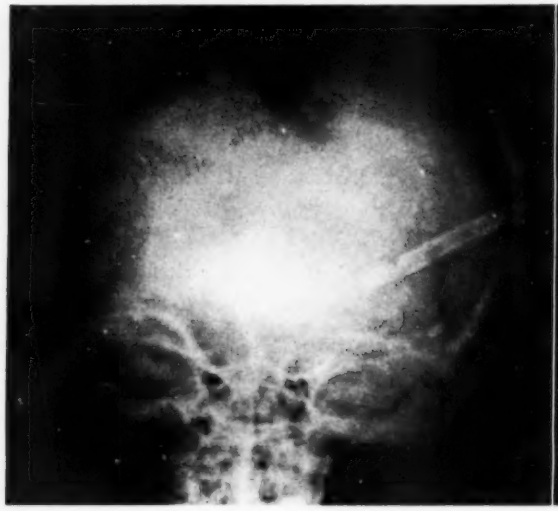

Fig. 1.

Fig. 2.

Figs. 1 and 2. Roentgenogram of skull (after operation) showing circular area of decompression in left parietal region. Drainage tube in situ extending into abscess cavity.

74.1 mgm per 100 c.c.; Wassermann 4 plus; and culture showed no growth. The urine was negative except for 1+ albumin.

Diagnosis. Right chronic adhesive otitis media; left chronic purulent otitis media with an acute exacerbation; left temporosphenoidal brain abscess; complete heart block with severe myocardial damage.

Operation. On March 5 a vertical incision over the left temporoparietal region was made about one inch above the tegmen region through the soft parts which were then elevated and retracted. A round defect in the bone was created with a one inch trephine exposing the dura which was under pressure but not necrotic. A strip of iodoform gauze was packed tightly around the circumference where the edge of the bone met the dura. The dura was incised for about ½ inch. A brain cannula was introduced for about 4 or 5 cm. forward and inward. No resistance was encountered, and pus made an immediate exit. The abscess cavity was allowed to empty itself slowly of about 4 or 5 oz. of a foul creamy pus, aiding it by moving the head from side to side. The dura incision was then lengthened to about ¾ of an inch. A small herniation occurred and the protruding brain tissue was removed. Two inches of a 15 F. rubber catheter with fenestrated end was introduced into the abscess cavity and an overhang of about one inch was split and sewed tuted later, consisted of six injections of bismuth in oil and protoiodide of mercury by mouth.

Progress. Immediately after the operation the pulse rate was 48, temperature was 100.6 F., respirations 16. An electrocardiogram postoperatively showed the presence of a complete A.V. dissociation.

A culture of pus obtained from the brain abscess grew Streptococcus non-hemolyticus and Staphylococcus aureus. A direct smear showed gram-positive cocci in short chains. Cultures made from March 10 and ending April 13, showed the following types of bacteria: Staphylococcus albus, gram-positive cocci in chains, Staphylococcus aureus, streptococcus and gram-positive bacilli.

The patient improved immediately following the operation; she responded to questions, and although she could not name objects she would describe their use. This aphasia lasted about a month. The right lower facial weakness continued to be present, but less marked, until it became very questionable by May 11. Deviation of the tongue lessened gradually and disappeared entirely. The left pupil was dilated no longer; both pupils were equal and responded to light and accomodation; choked disc was more marked on the right side with hemorrhages in the left but all disappeared by April 20. The patient was now able to raise

the right arm, except for a slight weakness which disappeared later. Hearing was fair.

On March 8, an electrocardiogram was taken and three-quarters of an hour later atropine sulphate grain 1/150 was administered and another electrocardiogram taken. The first one taken on this day resembled that of March 5, but the one following atropine showed an increase in the ventricular rate 40/60, but complete dissociation of A.V. was still present.

Another electrocardiogram on April 2 showed that the dissociation was not apparent as readily but the widened and prolonged P.R. interval and irregular T waves showing T and P waves confined and superimposed indicated the dissociation.

No pus drained from the wound until three days postoperatively, after which there was a scant sanguinopurulent or a sanguinous discharge. At times some brain tissue was expelled. This was sectioned and reported to be edematous and infiltrated by polymorphonuclears, and in one area showed an overlying purulent exudate. The laboratory diagnosis was brain tissue with inflammatory changes. A tract was established gradually within which the catheter drain could be moved in and out without difficulty. An *x*-ray picture after the operation (Figs. 1 and 2) of the left lateral and anteroposterior views showed a circular area of bone removed from the left parietal area with a shadow of one rubber drainage tube extending downward and inward for about 2 inches into the cranial cavity, and was reported by L. P. Vanwinkle. This drain was changed every other day, using a 15 and then an 18 F. catheter. The drain was shortened to one inch and finally removed on April 13. Temperature was then 99.2 F., pulse rate 60, and on April 18 the patient was discharged from the hospital with a normal temperature, pulse rate 46 and respiration 18.

The left ear had no discharge, but a small granulomatous mass was seen in Shrapnell's area.

The last electrocardiogram taken on May 8, after the patient was discharged from the hospital still showed complete A.V. dissociation.

DISCUSSION AND CONCLUSIONS

Kaplan* suggests the following fundamental rules in the treatment of brain abscess: (1) evacuation of abscess; (2) proper sealing of subarachnoid space with coagulating current; (3) Mosher drain; (4) accurate visualization; (5) allowing herniation according to King; (6) the initial and complete removal of primary focus of infection.

1. "*Complete evacuation of the abscess*" is essential. This is only assumed to have been accomplished for small pockets of pus may remain without symptoms, and a delayed death may occur; alcohol and trauma may relight the process. Emptying of the abscess may be aided by moving the patient's head from side to side, while the cannula is still in situ, and during the dressings. Drawing off the pus with a syringe, should be avoided, for it tends to seal the walls of the abscess.

2. "*Sealing,*" according to our best knowledge a protective meningitis usually occurs in the subarachnoid space and in the presence of a high leucocyte count as in this case, makes it very likely that this occurred. The application of the coagulation current is of value. In the absence of a coagulation apparatus, a strip of iodoform gauze can be easily packed around the edge where the bone meets the dura, thus setting up a local inflammation with adhesion formation between the dural layers in about twenty-four hours, will answer the same purpose and give equally as good a result as coagulation. The packing may have an additional advantage, preventing an immediate overflow of purulent material from invading uninvolved subarachnoid space. In one of the cases reported by Kaplan, twenty-three days after sealing with the coagulation current, meningeal inflammation occurred, which was possibly a true meningitis.

3. "*Mosher Drains*"; 4. "*Accurate Visualization*"; 5. "*Herniation According to King.*" The Mosher drain has some advantages over any other but the incision in the dura must be longer, thereby permitting greater herniation. If sealing has not occurred spontaneously or it has not been induced by the coagulation current or

* Kaplan, Abr. *Arch. Otolaryngol.*, 21: 385–405 (April) 1935.

the iodoform packing, there is a great possibility for the pus to roll over the edge of the dura and start an acute meningitis.

6. "*The Initial and Complete Removal of the Primary Focus of Infection.*" The ideal treatment of brain abscess, according to Eagleton, is through a stalk, but unfortunately we have no method for predetermining its presence. In a case similar to the one here reported, we first proceeded with the mastoid operation in an attempt to remove the source of infection. Our findings of sclerotic bone, a forward sinus and an obliterated antrum, required consumation of time in that preliminary surgical procedure, but no bone erosion or purulent invading tract was found. Hence, in the presented case, surgical shock was avoided and time saved by omitting the mastoid operation and proceeding directly to relieve the pressure symptoms by evacuating the abscess. We felt that if channels of infection existed from the mastoid, the protecting exudate which Nature provides, combined with the surgical collapse of the abscessed cavity would aid to obliterate them. The radical mastoid operation can await decision as to whether or not it should be done at some future date, thus giving the patient a breathing spell. We feel that the evacuation of the abscess should receive first consideration. Extradural abscess, as well as temporosphenoidal abscess, give aphasia. The fact that the aphasia cleared so rapidly postoperatively in this instance without mastoid operation indicates that no extradural abscess was present and that we were justified in electing to delay the mastoid surgery.

In Jackson Coates (1929) the following by Eagleton appears under "Non-localizing Paralysis." "An inequality of the pupils is of little localizing value. It is evidence of cerebral involvement, but a contracted pupil of the homolateral side from irritation may be of assistance." The writer's experience has been that a dilated pupil on the side of the involved ear is of significance and is an important sign of cerebral pressure in a temporosphenoidal brain abscess. The pupil is supplied by the third nerve and when it is involved by pressure only the sphincter fibres are affected giving a unilateral mydriasis. A dilated pupil is an important localizing sign of a temporosphenoidal abscess and occurs on the side of the lesion. Syphilis and meningitis must be excluded by the presence of the light reflex. Because of the pressure paralysis of the sphincter muscle of contraction the sympathetic nervous system dilates the pupil and a contracted pupil means a loss of sympathetic action.

The question of a broken down gumma may be disregarded because of the presence of the light reflex, labyrinth response to caloric stimulation and fair hearing. In syphilis the cochlear branch is the one involved most frequently.

Encapsulated or Non-encapsulated Abscess. Kaplan assumes that it takes about six weeks for a capsule to form. A capsule would have given some resistance to the entrance of a cannula but since none was encountered it is fair to assume that this was an acute non-encapsulated abscess of short duration. An encapsulated abscess is prone to give localized headaches, which were not present in this case.

The bradycardia continued to exist postoperatively and was due to syphilis, but the difference between the pulse of 28 before operation and 48 after operation, was due to the cerebral pressure. In the presence of a very slow pulse, syphilis of the heart should be considered as part of the etiological factor which is causing the bradycardia.

SUMMARY

A patient with a history of chronic ear suppuration was admitted to the otological service. A diagnosis of left temporosphenoidal abscess was established and it was operated upon within twenty-four hours. Pressure symptoms gradually abated until at the time of discharge the sensorium was functioning normally. The patient has since gained twenty-four pounds, and had no complaints when examined on August 29, 1936.

NEW INSTRUMENTS

IMPROVED TISSUE FORCEPS*

CARL W. WALTER, M.D.

Arthur Tracy Cabot Fellow in Surgery

BOSTON, MASS.

THE more general adoption of silk as a suture material has led surgeons to refine existing surgical instruments to permit precise, gentle technique as well as to facilitate the handling of fine silk.

The tissue forceps illustrated[1] were designed with finely tempered springs requiring so little force to oppose the teeth that the operator obtains a sense of tissue resistance. Sharp, hardened mouse teeth insure a firm grip with a minimum of trauma to the tissues. The elliptical heel of the forceps is bevelled to a blunt, poker-like edge to serve as a dissector as well as to facilitate picking out individual sutures from a group held taut by an assistant. The length of the forceps, together with the ease of the spring makes palming of the instrument easy so that it may be retained readily in the palm throughout an operative procedure. The forceps can be used continuously without fatigue of the adductor and opponeus groups of thenar muscles.

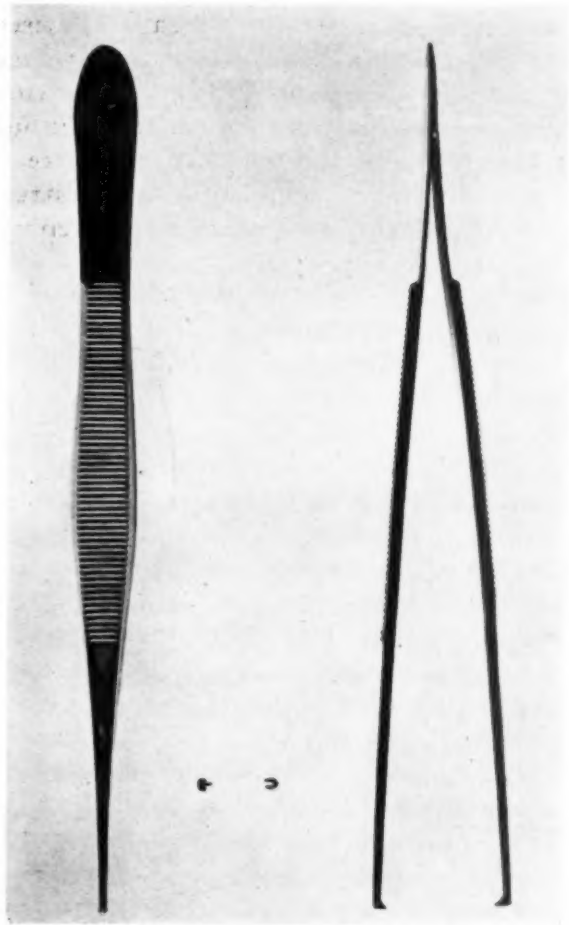

FIG. 1.

[1] Made by Bard Parker Company, Inc., Danbury, Conn.

* From the Laboratory of Surgical Research, Harvard Medical School and the Surgical Clinic, Peter Bent Brigham Hospital, Boston.

APPARATUS FOR CONTINUOUS SUCTION BY SIPHONAGE*

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Former Resident-in-Private, Lenox Hill Hospital, New York

FOSTORIA, OHIO

THE value of continuous suction through a Levine tube (nasal catheter) in cases of acute dilatation of the stomach was demonstrated by Ward[1] who described an apparatus which he devised for this purpose. Wangensteen[2] constructed a simpler apparatus for obtaining continuous suction and first called attention to the value of this method in the treatment of cases of acute intestinal obstruction.[3] He later published additional reports regarding its use in intestinal obstruction[4,5] and in a paper on empyema[6] mentioned its use in the treatment of that condition. More recently[7] he has suggested its use in the non-operative treatment of cases of localized duodenal perforation.

The Wangensteen apparatus has been used at Lenox Hill Hospital in cases of intestinal obstruction, acute dilatation of the stomach, postoperative distention and vomiting, peritonitis, etc., with very gratifying results which have demonstrated conclusively the value of the method. While using the apparatus, however, several disadvantages in its practical application became evident. The suction obtained by the Wangensteen apparatus depends on the flow by gravity of tap water from bottle *A* suspended upside down in a canvas container into the floor bottle *B*, (Fig. 1, solid lines). Aspirated fluid entering bottle *A* through the long glass tube mixes with the tap water in this bottle and then also flows into the floor bottle *B*. For this reason and because bottle *A* is encased in a canvas container it becomes somewhat difficult to determine the exact character of the fluid material aspirated. Aspirated gas replaces the water in bottle *A* allowing it to flow into the floor bottle *B*. When bottle *A* is empty it becomes necessary to take the apparatus apart, clean both bottles, refill bottle *A* with tap water and again suspend it as shown in the diagram. Apparently in an effort to overcome this objectionable feature Wangensteen later modified the original apparatus by using an upper bottle with a hole cut in the bottom for refilling.[8] Carmichael and Guffy[9] have recently suggested modifying the Wangensteen apparatus by adding a third bottle *C* as shown in the diagram (Fig. 1, broken lines). This bottle acts as a receptacle for the fluid material aspirated thus preventing its contaminating the tap water in the other two bottles and allowing for the ready determination of its character. It does not however eliminate the necessity for refilling bottle *A*.

The apparatus shown in Figure 2, is reported not because it offers any better therapeutic results but because it proved simpler and easier to handle. The material necessary for its construction is readily obtainable and inexpensive. It consists of three transparent bottles equipped with two-hole rubber stoppers, glass and rubber tubing and two clamps. The five-pint, wide-mouth bottles used by many pharmaceutical houses are very suitable for this purpose. The apparatus is set up on a bedside table as shown in the diagram. All of the connections must be air-tight or the apparatus will not function properly. Bottle *C* acts merely as a receptacle for the fluid material aspirated while bottles *A* and *B* furnish the necessary negative pressure or suction. Bottle *A* is filled with tap water and a flow of water by siphonage from bottle *A* into *B* is started by disconnecting the tubing at *E* and blowing

*From the Surgical Service, Lenox Hill Hospital, New York City.

on the short glass tube in bottle *A*. The tubing at *E* is reconnected and the clamp at *G* is now closed until the Levine tube has been introduced into the patient's stomach and connected to the apparatus as shown. When this clamp is opened continuous suction is started.

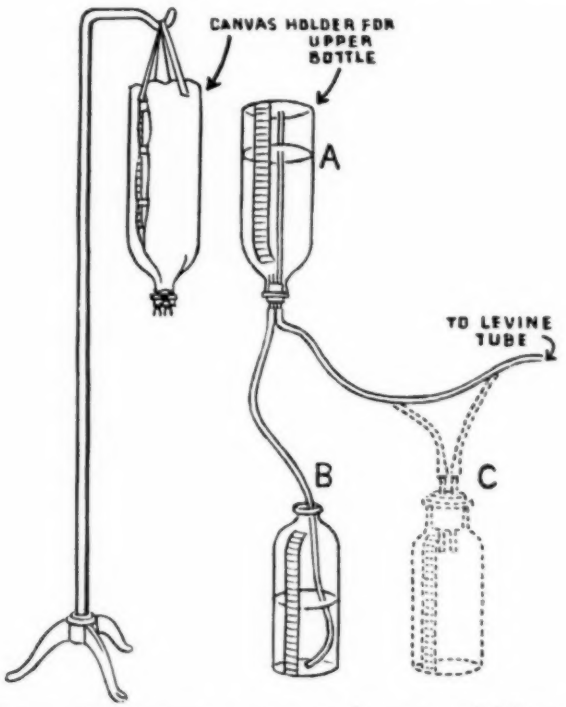

Fig. 1. Wangensteen apparatus shown in solid lines; Carmichael and Guffy suggest the addition of bottle c shown in broken lines.

When bottle *A* is empty its refilling is eliminated by replacing it with bottle *B* which is now full. The bottles are simply interchanged and the rubber tubing connection at *E* changed to *F*. The clamp at *D* is closed while the exchange is being made. If the exchange is made before the water level in bottle *A* gets below the level of the long glass tube the siphon already established will be maintained and will not have to be restarted. This exchange of one bottle for the other is repeated as often as necessary to maintain continuous suction.

A knowledge of the amount of fluid and gas aspirated is very helpful in indicating what is being accomplished. For this reason the bottles are graduated by pouring measured amounts of water into them and marking the calibrations on a strip of adhesive tape fastened to the side of each bottle. Bottle *C* is graduated from below upward and bottles *A* and *B* are graduated from above downward. Since the aspirated fluid collects in the graduated bottle *C* its amount and character can be determined at a glance. The drop in water level of the table bottle (*A* or *B* as the case may be) represents the total volume of both fluid and gas. The amount of gas aspirated can then be determined by subtracting the fluid volume from the total volume.

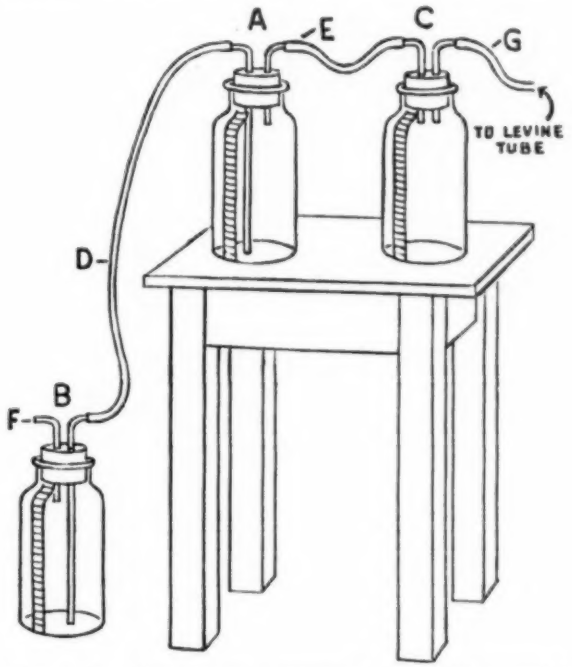

Fig. 2. Bottle c acts as a receptacle for fluid material aspirated. The flow of tap water by siphonage from bottle a into b furnishes the negative pressure or suction.

In order to prevent the openings in the Levine tube from becoming plugged with mucus and debris it occasionally becomes necessary to irrigate it with warm soda bicarbonate solution. The clamp at *G* should be kept closed while the Levine tube is disconnected for this purpose.

The foregoing described apparatus has been tried in a sufficient number of cases to demonstrate its practicability and ease of operation. It has been used in various gastrointestinal disturbances and has also been used to withdraw air from the pleural

space to favor reinflation of the lung following lobectomy and to keep the urinary bladder empty following suprapubic cystostomy.

When this communication had been prepared for publication my attention was drawn to the fact that the principle involved of obtaining suction by reversing the flow of water from one bottle to the other had been described previously by Bunsen. The Bunsen apparatus is illustrated and briefly described in a German textbook on operative surgery.[10] It differs from the described apparatus in that the flow of water from one bottle into the other takes place by gravity rather than siphonage and for this reason special bottles with openings near the bottom are required. So far as I know, no apparatus using this principle has been described in the English literature.

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A NEW ELECTROSURGICAL SNARE

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NEW YORK

MODERN electrosurgical technique is now recognized as the selective method in many operative procedures and the advantages offered by the various electrical modalities, used alone or in combination, are gradually being adopted by the several specialties.

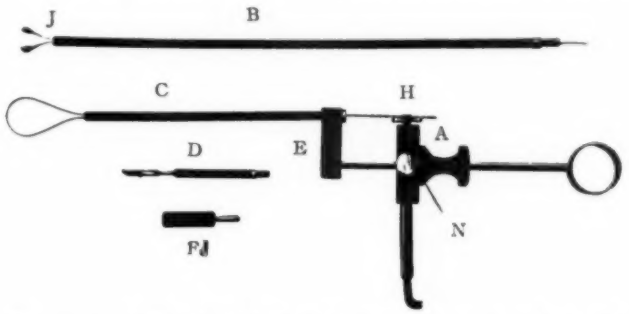

FIG. 1. A, sliding knobbed unit; B, C, D, 12, 6 and 3 inch shafts; F, adapter for shafts; H, circular nut for securing snare and biopsy wires; N, set screw for sliding unit; J, biopsy cups.

In the general surgical field, and particularly in cancer surgery, the cutting current combined with electrocoagulation has offered the desirable and advantageous features of less hemorrhage, less time consumed in ligature tying, more complete destruction of malignant cells and less chance of dissemination by implant or lymphatic spread.

Likewise many surgical procedures involving the mouth, vagina, bronchi, esophagus and rectum have been simplified to a degree, heretofore impossible, by the advancement in electrosurgical methods and the introduction of new apparatus and electrodes.

A new electrosurgical snare has been devised which is simple, readily adjustable and applicable to a variety of electrosurgical procedures. It was particularly designed for the snare removal of rectocolonic adenoma but it has proved quite useful, not only in general surgery but also in gynecological, nose and throat and bronchoscopic electrosurgical maneuvers.

Its particular advantage consists in that the usual full ringed handle has been replaced by a knobbed unit *A*, Figure 1, which permits of better vision and greater finger mobility when working through a bronchoscope, proctoscope or vaginal speculum.

The shafts, *B*, *C*, and *D*, Figure 1, are 12, 6 and 3 inches in length and are screwed into the body of the snare, *E*, for greater security. These shafts may be readily converted into the conventional electrode handle, *O*, Figure 2, by the simple attachment of the adapter *F*, Figure 1, and any of the various electrode tips shown in Figure 2 may be used on this converted handle for general surgical purposes as breast amputation, laparotomy, removal of skin tumors, tonsil coagulation, conization of the cervix, etc.

If desired the shafts may be left on the snare and any of the electrode tips screwed in and the entire snare used as a hand electrode. The circuit is completed by simply pushing the sliding knobbed unit *A*, in

contact with the body of the snare as shown in *M*, Figure 2, and securing it with the set screw, *N*.

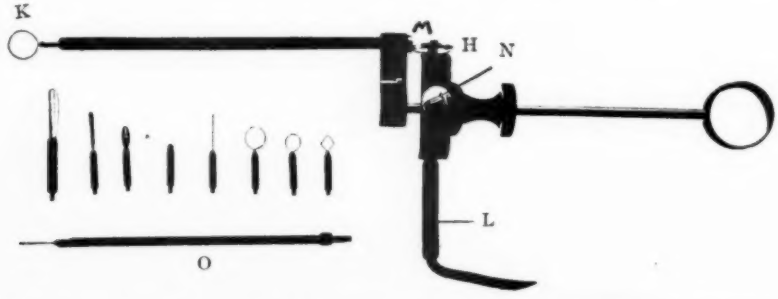

Fig. 2. M, contact between sliding unit and shaft; H and N, same as Figure 1; O, 6 inch shaft converted to ordinary electrode handle; K, closed biopsy cups used as electrode tip.

The circular nut shown at *H*, Figure 1, permits of a quick and secure adjustment of any snare or biopsy wire to any desired length and at any angle, an important consideration in removing an adenoma from the rectum or sigmoid.

The excision of biopsy specimens from the mouth, vagina, bronchus, esophagus or rectum is a particular feature of this snare since it may be used either cold or electrified. After the biopsy specimen has been secured by the cups shown in *J*, Figure 1, and delivered, the traumatized area may be readily coagulated by simply stepping on the footswitch and using the closed biopsy cups as a ball electrode, as shown in *K*, Figure 2.

The unit *L*, is a spindle connection.

Any mono- or bipolar current may be delivered through this snare from any type of high frequency machine.

ONE-STEP TECHNIQUE FOR DRAINING BRAIN ABSCESS*

EMIL SELETZ, M.D.

LOS ANGELES, CALIF.

A SIMPLE technique and a new drainage tube has been devised for the drainage of intracerebral abscess. This technique makes it possible to locate the abscess and insert the tube within a single step.

This tube is of a semirigid consistency, thin walled and with a lumen wide enough to permit its passage over the standard size ventricle needle.[1] It may be sterilized by boiling or autoclave. The tube may be cut with scissors and sutured to the subcutaneous tissue and scalp, yet it is sufficiently rigid so that it will not collapse.

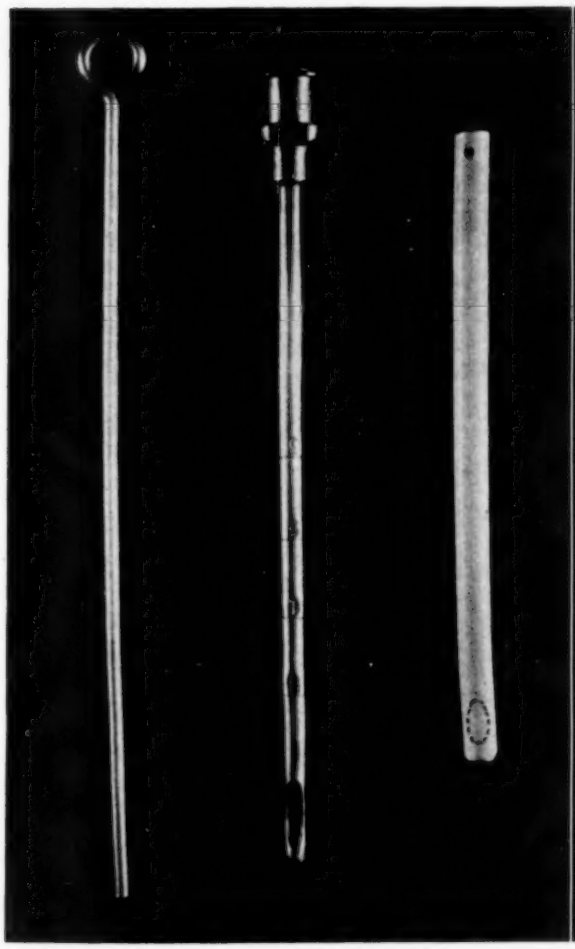

FIG. 1. Separate parts of drainage instrument consisting of stylet, ventricular needle and drainage tube.

FIG. 2. Assembled instrument.

[1] Tubes of different organic media are being tried, to be reported later, but a standard tube of celluloid material was conceived and perfected by Mr. J. J. Cantor of the Surgical Mechanical Research Laboratory of Los Angeles. At our suggestion, Dr. R. B. Raney, of Los Angeles, began using the ordinary goose-quill as the tube employed in this technique, with excellent results.

* From the Neurosurgical Service of Dr. Carl W. Rand and Dr. G. H. Patterson, Los Angeles County General Hospital, Los Angeles, California.

TECHNIQUE

The tube is passed over the ventricle needle, which it fits snugly like a sleeve,

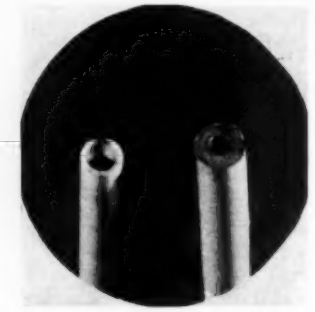

Fig. 3. Lumen of new drainage tube compared to lumen of 18 F. catheter.

and the combination is then used as a single instrument in locating the abscess. The accepted small scalp incision and drill hole is used. The tip of the ventricle needle projects beyond the end of the tube so that the sensation of piercing the abscess capsule with the ventricle needle is not altered for the surgeon who is familiar with this procedure.

When the abscess cavity has been entered and confirmed by the removal of the ventricle needle stylet, the ventricle needle may now be withdrawn from the tube, leaving the tube alone in the abscess cavity. Thus the abscess is found, entered and the tube for drainage left in situ, all within the single step. The tube can now be cut off to the proper length and sutured to the scalp.

ADVANTAGES

1. There is no danger of losing the abscess once it is found;
2. The opening made in the abscess capsule fits snugly around the tube;
3. The abscess is pierced only a single time, thus preventing the escape of pus into the intracranium;
4. The outside diameter of the tube is relatively small, being half the diameter of an 18F. rubber catheter, while the lumen is six times the diameter of the 18F. catheter, thus insuring adequate drainage;
5. The tube can be sutured in place, and when the time arrives for shortening the tube it can be cut with suture scissors;
6. The semirigid quality prevents the tube from bending and obliterating the lumen;
7. The abscess is located and drainage tube inserted in one and the same step.

Seven intracerebral abscesses have been drained by this technique.

[From Fernelius' Universa Medicina, Geneva, 1679.]

BOOKSHELF BROWSING

SCOTCH AND IRISH SURGERY

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MIDDLETOWN, CONN.

THE Royal Infirmary at Edinburgh built of dark gray stone seems grimly aged with its towers and turrets. Its main entrance of many wide steps leads up to an arch whose keystone is inscribed with the Latin "Patet Omnibus." On either side of the Latin are the quotations "I was a stranger and ye took me in" and "I was sick and ye visited me." The hospital lives up to its Latin invitation to everybody. Any citizen of the world may enter and obtain all that the services afford and no questions will be asked as to who will pay the bill, and no bill is ever presented. This does not necessarily mean that the Scotch take good care of their sick, for the Infirmary has a waiting list of 3000.

Professor Frazer was away in Australia helping dedicate the new home of the Australian College of Surgeons. Professor Wilkie was at work. The term Mister is used in addressing individually all the other Edinburgh surgeons, a custom perhaps harking back to the time of barber surgeons, who, as they became better and better educated, finally looked down upon "doctors" and refused to be addressed by such a term.

Professor Wilkie's staff was conspicuously devoted to its chief. The operating room force seemed to be desperately striving to anticipate every want of Wilkie. A patient was anesthetised before the surgeon's arrival. When Wilkie appeared in a doorway, an alert nurse rushed across the operating room to hurry on his rubber apron, and from that moment he was not permitted to ask for anything. In contrast to this state of activity of his assistants Wilkie himself was most deliberate, reading the case record himself, interpreting his films and discussing the case most thoroughly and with fascinating clarity.

One anesthetist appeared to be surprisingly elderly, around the age of seventy-five. Ether and nitrous oxide were in use with some inductions with chloroform. Wilkie had discontinued spinal anesthesia. He said that an ether death was precipitate and soon forgotten but an untoward after effect of spinal anesthesia, such as paralysis, was hospitalized for months, exasperating the surgeons and upsetting the morale of the hospital. Wilkie said he could not operate at his best with the thought in mind that he might have the experience with his patient that was re-

ported of a young farmer, coming into the hospital for a herniotomy and remaining there for six months with paralysis of the legs, to the consternation of all connected with the case. There was no explanation of the accident and no way known to prevent its duplication in the next patient.

Wilkie on successive days did splenectomies on two young girls, cases of thrombocytopenia with serious hemorrhages. His especial interest in this condition was in the splenic ligaments which he claims to have first noted. By severing the fascia and these ligaments externally to the spleen he is able to deliver the spleen extra-abdominally, thus making easier the tying off of gastric, adrenal and pancreatic arteries. Moynihan told Wilkie that his ligaments are old adhesions, the two surgeons having had considerable contention over the point. Certainly Wilkie removes the spleen with great facility.

Wilkie mentioned, among the other details, that a transfusion should always be given a half hour before these splenectomies to avoid otherwise uncontrollable bleeding during the operation. He also mentioned that one-half hour after the removal of the spleen the patient would be relieved of all tendency to bleed. A stomach tube inserted before operation prevents a ballooning stomach from overlapping the spleen.

Most blood vessels in ordinary operations, instead of being ligated in this clinic, were controlled by electrical coagulation. Wilkie stated that the cautery knife was followed by too much postoperative oozing but that this was not the case in the electrical treatment of blood vessels.

While operating on a rectal case Wilkie stressed the fact that there should be no pain after a hemorrhoidectomy and consequently no retention of urine from the use of morphine. He prevents such pain, first by not traumatizing the sphincter muscle which he is able to see and avoid, as he does not thin it out by stretching. He prevents pain, second, from hematomata by leaving the pile area well drained. Third, he lessens pain from local sepsis by exhibition of laxatives forty-eight hours preoperatively and enemata never later than twelve hours preoperatively. "The most septic bacteria being in the lower part of the small intestine" and peristalsis of that part of the gut being induced by enemata, an enema on the morning of operation floods the operative field with virulent organisms and tends to produce more inflamed tissues postoperatively with accompanying pain.

At this clinic, and at most Scotch and Irish clinics, abdominal wounds were closed by the use of the French Reverdin needle. Difficult closures were accomplished most conveniently. Many varieties of these eye-at-point needles were displayed in the instruments shops.

Skin grafting was very simply done. A flat slab of dental wax was warmed and fitted to the granulating area. Then thin skin shavings were placed upon the wax which was applied to the raw area and left there ten days.

The Scotch drink tea between operations in the same way that they do during a game of cricket. Wilkie, after an operation, takes his guests and assistants into an adjoining room and leisurely discusses the operation while everybody partakes of tea and sandwiches. These little occasions were most pleasant and profitable.

Not far from Wilkie's highly organized modern operating suite in the same hospital we came across an ultra conservative surgeon who prided himself on his independence of face mask and rubber gloves. He said that he only wore a mask when he had a cold. He spoke of a colleague, deceased several years ago, who never wore gloves, and who obtained "as good results as any surgeon." The cordiality was of a high grade in this conservative atmosphere but I was advised by the operator that I would not be edified by his technique and had better see his colleagues work. However, he seemed to be attacking difficult problems.

George Stevenson occupies the chair of Macewen in the Royal Victoria Hospital

of Glasgow. Stevenson showed us the site of Lister's operating room. After long consideration the aging structure had been torn down. A large plaque marks the place of the building wherein Lister used his carbolic spray. Lister's splints are still to be seen in the splint room, and a carbolic atomizer is preserved in the hospital, although Lister's instruments are in the museum of the Royal College of Surgeons in London.

Chloroform bottles were plentiful in Stevenson's operating room as here it is used routinely for the induction of ether. Stevenson had recently had a death three minutes after the administration of spinal anesthesia. He also had had two postoperative sloughs after the use of spinal anesthesia. He believed spinal anesthesia required more nurses than he could muster to watch patients after operations.

One anesthetist was using paraldehyde in place of avertin.

Stevenson pointed from a hospital window to a large cemetery extending some distance from under the eaves of the building and told us that in the old days, as a convenience, a cemetery was part of a hospital outfit as people entered a hospital specifically to die. Medical students obtained dissection material in these hospital cemeteries. This thievery was thwarted by the laity placing large blocks of iron over newly made graves. An air space was left extending down to the bodies permitting rapid decomposition, and preventing dissection, so that in a few days the block of iron could be used over a new grave.

In this old custom of hospital cemeteries perhaps originated the modern prejudice amongst a certain class of people against "going to" a hospital.

An amusing custom of some Scotch hospitals is the defraying of travelling expenses of the staff from the exchequer of the hospital. Each member of the visiting staff is paid $250 or more yearly to provide for cost of travelling to and from the hospital.

At Belfast we found Lt. Col. A. B. Mitchell to be a most delightful personality. He had retired from the practice of all surgery at the age of seventy years, believing that surgeons at that age should give over all their work to younger men. Thus much embarrassment and heartache would be saved for the young men assuming their old friend's practice, and for the old surgeon in seeing his work slip away from him. Col. Mitchell had been one of the first men on the British Isles to attempt stomach surgery and had played an important part in placing such surgery on its modern basis. He was now occupied with many activities, such as membership in the Ulster Parliament and chairmanship of the hospital Board of Governors. He showed us an addition to the Royal Victoria Hospital of Belfast in which the wards and operating rooms were so arranged that the patient experienced no change of atmosphere in being carried from one room to another. Mitchell believed that he had cut down postoperative pneumonia 50 per cent by this arrangement.

Mitchell told an interesting story of his attempting to teach a Japanese student the technique of hair lip operations. The student observed "But there are no hair lips in Japan." All Japanese infants born deformed are allowed to die. Mitchell was very emphatic in his suggestion that idiots and similar burdens of charity should be exposed to monoxide gas for a few minutes.

Mitchell was a member of the group of Colonels of the Royal College of Surgeons who had presented the Great Mace to the American College of Surgeons.

We saw Professor Crymble at work in the Royal Victoria Hospital at Belfast. He, like Wilkie, had an elderly man as anesthetist and this man, too, was inducing ether anesthesia with chloroform. We asked him whether or not there were any chloroform deaths. He answered casually that there were fatalities in eye and tonsil cases and where internes were giving chloroform, but in general surgery with regular anesthetists "there was not much trouble."

Professor Crymble is interested in gastric surgery and has released some important literature on that subject teeming with original ideas. He is using avertin extensively with children, and in 200 cases of acute appendicitis in children he claims to have reduced his death rate by the use of avertin anesthesia.

Boyd, at the Belfast Hospital for Sick Children, has used avertin in a series of 700 children from three to thirteen years of age with no anesthesia deaths. One case had multiple brain abscesses and died ten days postoperatively and another which had an inoperable tumor and died three weeks postoperatively, were the only deaths. Avertin was used alone in 398 cases: avertin and ether in 149 cases: avertin and novocain in 117 cases: avertin and ether and novocain in 36 cases. Where avertin was used alone the vomiting was 9 per cent: where other anesthetics were added 17 per cent vomited. Only 18 cases gave Boyd any anxiety concerning the anesthesia. Of these, 8 became pale: 5 had shallow respiration and 4 were in shock after operation. All improved after coramine was administered. A larger proportion of children were operated under avertin alone recently, a catheter with a funnel attached being left in the rectum to prevent the partial expulsion of avertin as occurred in the early cases. Children stand a larger dose proportionately than adults. Morphine was also sometimes added after it was seen that the avertin would not furnish a complete anesthesia.

Avertin improved the morale of the children's wards by abolishing fear of operation.

In Dublin there are no large surgical clinics, the surgical material being divided among several hospitals. On entering the Stevens Hospital we were startled by a noise like thunder. We asked what had happened and were shown a gong the size of a base drum by which the arrival of the visiting surgeon is announced. Irish patients, we were told later, are not nervous and make good surgical risks.

O'Connell, at Stevens Hospital, was active in brain surgery and had a ward of interesting cases.

At this hospital we heard Slattery discussing chloroform anesthesia. He said that at a base hospital in war time chloroform with ether had been given by specialists to 25,000 cases with no deaths, and that later when a change was made to nitrous oxide and ether there were many deaths from lung complications.

Solomon, formerly in charge of the Rotunda Maternity, was conducting a clinic at Stevens. He is one of three Irish surgeons who are members of the American College of Surgeons. In his operating room one day there were medical men from India, South Africa, Australia, Canada and the United States. Schiller, a gynecological pathologist from Vienna, was also present as he was giving a course of lectures in Dublin. Solomon was using picric acid as his antiseptic. He remarked that any antiseptic was good if it hardened the skin. Solomon removes the cervix in all of his hysterectomies unless the cervix is normal. Schiller remarked that in a large series of removed cervices no more cancerous lesions were found than in average women.

In discussing spinal anesthesia Schiller said it was used by all Vienna gynecologists. Solomon said that after using spinal anesthesia for 600 cases he had given it up for the reason that if patients died, it was impossible to tell how much the anesthesia had to do with his mortality percentages, and he wanted to know why a patient died.

Solomon states that in Ireland tuberculosis of the tubes is a frequent cause of sterility. Other causes of sterility are infrequent except in women who have been in Australia or America. In speaking of cesarean section Solomon stated that in 4000 labors at the Rotunda only 14 cesareans had been indicated. He believes that the ease with which this operation is performed has caused it to be often abused.

At the Meith Hospital, Thomas Lane had a well organized clinic. We asked

him what his namesake in London had contributed to surgery of permanent value. The Lane bone plates were mentioned.

Lane was using routinely tracheal anesthesia according to the technique of McGill of London, except that owing to frequent bleeding of the nose, the mouth intubation had been substituted. Certainly a most instantaneous control of the patient's condition is obtained by this method. Thyroidectomies cannot be performed under tracheal anesthesia for the reason that a very deep anesthesia is needed at first to permit insertion of the tracheal tube. Then again the trachea might collapse on the withdrawal of the tube, and the collapse be overlooked.

In most of these hospitals Finsterer was regarded as the leading surgeon on the continent.

We should not forget to speak of the hearty cordiality extended to visitors at all Scotch and Irish clinics. In many instances uncalled-for kindnesses were shown us, such as conveyance between hotel and hospital, and invitation to teas at the homes of the surgeons.

BOOK REVIEWS

A Textbook of Obstetrics. By Edward A. Schumann, A.B., M.D., F.A.C.S. Pp. 788 with 581 illustrations on 497 figures. Philadelphia, W. B. Saunders Company, 1936. Price $6.50.

Though one knows a man, even casually, and has followed his career, and on numerous occasions listened to him lecture on subjects of his specialty, always finding him interesting and instructive, a review of his book might easily be written from the point of view of personal bias. Although this could happen in this instance, we did go carefully through Professor Schumann's new Textbook on Obstetrics with a cold, critical eye, and found it to our liking and decidedly worthwhile.

Dr. Schumann has compressed all the essential facts into a book of 788 pages which includes the Index. There is no need to review at length the various chapters or special headings. Being a teacher of long experience the author knew what to emphasize and what to relegate to a paragraph or two. Essentially a textbook for students and practitioners in medicine, the practical plays the major role and speculation and theory are omitted entirely or given scant space. There are three or four good books on obstetrics on the market but if one is looking for a compact, to the point, practical work, Dr. Schumann has provided such a text.

The illustrations are adequate. At the end of the book a bibliography is given under each chapter heading. The Index is complete.

Diseases of the Testicle. By Hamilton Bailey, F.R.C.S. (Eng.). Pp. 165 with 129 illustrations of which 10 are coloured. London, H. K. Lewis & Co. Ltd., 1936. Price 12 s. 6d. net.

This is a compact and well written monograph on diseases of the testicle. The author has packed into 165 pages the most modern thought on this subject. The illustrations are well done and the color work especially good. At the end of each chapter are references from the literature for those who wish to go deeper into a given subject. There is an Index.

To urologists and physicians who are interested in this subject this work is earnestly recommended.

Modern Urology. In Original Contributions by American Authors. Edited by Hugh Cabot, M.D., LL.D., F.A.C.S. Two volumes. Third Edition, thoroughly revised. Illustrated with 546 engravings and 12 plates. Philadelphia, Lea & Febiger, 1936. Price $20. net.

This work, consisting of two octavo volumes totaling 1813 pages and profusely illustrated, is well known to urologists of all countries and to many physicians in other branches of medicine. It has earned the reputation of being solid, slightly conservative but at the same time just a step ahead of the times. Its contributors, thirty-five in number, represent the leaders of the urological specialty. Each one is an authority and is so acknowledged in all medical circles.

Therefore, a third edition of this notable work, ably and discriminatedly edited by Dr. Hugh Cabot, Professor of Surgery, at the Mayo Foundation, is welcome. Naturally, since the last edition there have been great advances and changes in urology, and the revision and additions to the text have kept pace with this evolution. The publishers tell us that "So extensively has it been rewritten that it is practically a new work," and this is the truth, indeed.

This encyclopedic work meets every need for specialist and general practitioner. The illustrations are unusually well done. The Index is satisfying.

One word sums up this excellent work, and that word is, "sound." Cabot's Modern Urology conveys the impression that from every point of view it is a sound work.

PRACTICAL CLINICAL GYNECOLOGY

HENRY C. FALK, M.D., F.A.C.S.

FIRST INSTALLMENT

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Chapter IV

GONORRHEAL INFECTION OF THE TUBES

Gonorrhea in the female attacks primarily the urethra, Skeene's ducts, Bartholin's glands and the cervical canal (endocervix). In the acute stage the cervical discharge is very profuse and there may or may not be an erosion. In the chronic forms the cervix may appear entirely normal and yet one may express pus, a smear of which would show gonococci. Such organisms may remain in the cervix for a long time without giving rise to symptoms.

If the disease is not treated and if there is no further sex trauma or exposure the gonococci can disappear from the cervix in one to three years. In the male, however, the gonococcus does not disappear as readily as many urologists would have us believe. Pelouze (1934) stated that the most characteristic feature in the course of a male gonorrhea was its definite trend towards latency. In the 1936 report of the Research Committee on the gonococcus and gonococcal infections they state that in the male, "Extension of the infection to the posterior urethra greatly increases the likelihood of complications and the duration of the disease. A certain proportion of such cases apparently are never cured."

At this time the discussion will be limited to "upstairs gonorrhea," the disease from the internal os of the cervix upward.

Whether a gonorrheal infection remains localized to the cervix or whether that infection goes further and involves the tubes, depends upon the virulence of the organism and the susceptibility of the individual.

How and when do the gonococci ascend to the tubes?

Not every patient with a cervical gonorrhea develops salpingitis. The infection does not immediately ascend into the tubes. When a patient has a gonorrheal infection of the cervix it is usually one to three weeks before the first symptoms of salpingitis develop. Why?

Because most primary gonorrheal infections of the tube (not secondary) occur just after or during a menstrual period, following the emptying of the uterus or following some intrauterine or intracervical manipulation.

An acute surgical abdomen with a high polymorphonuclear count, 90 per cent, in a patient with a high temperature who does not look sick, occurring just after menstruation, with positive gonorrheal urethral smears is strong evidence that the patient is suffering from an infection of the tube as against an appendiceal involvement.

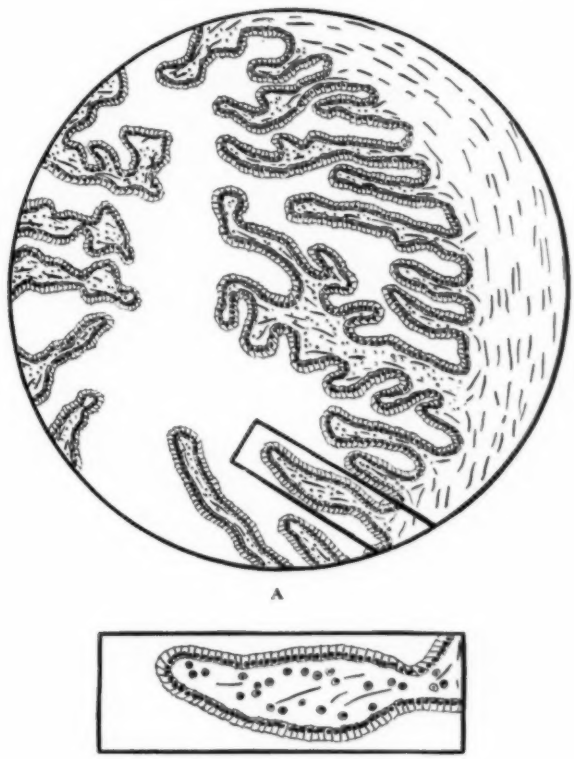
Many textbooks consider the mucus plug in the cervix as the most important barrier to the ascent of the gonococcus from the cervix to the tubes. It is rather difficult to accept the fact that a mucus plug which does not prevent spermatozoa from entering the uterus should prevent gonococci from ascending. Apparently there is something else besides the mucus plug, something in the uterine cavity, or in the endometrium, that acts as a deterrent to the advance of the gonococcus. This may sound paradoxical, as gonococci grow best in an alkaline medium and the reaction of the uterine cavity is slightly alkaline; and yet, it is an accepted fact that the reaction in the uterine cavity is changed in some way before the organisms ascend. The patient either begins to menstruate, has an abortion, delivery or some intrauterine instrumentation which not only removes the cervical plug but changes the reaction in the uterus thus allowing the gonococci to ascend and infect normal tubes. This infection is by direct extension along the endometrium, causing an acute endometritis which is very evanescent and difficult to demonstrate. The infection extends to both tubes simultaneously.

Histology

What happens histologically when the gonococci infect the tubes?

Normally the folds of the tube consist of a small amount of connective tissue covered by a single layer of ciliated epithelium. Each fold may have a small blood vessel present.

There are normally no gland-like spaces and no glands (Fig. 41). With the advent of the gonococci an acute inflammatory reaction occurs; the thin folds become markedly swollen, pus



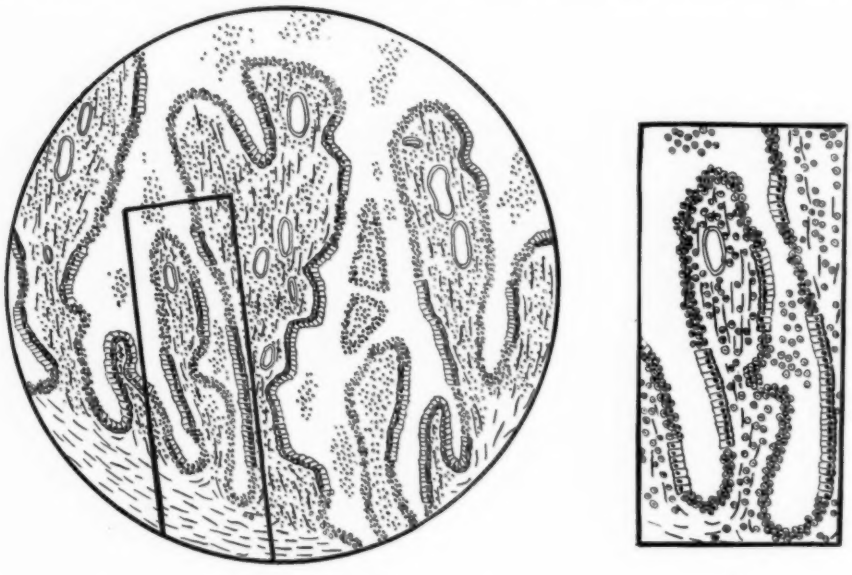
A

B

FIG. 41. A. Microscopic section of a normal tube showing the folds covered by ciliated epithelium. B, high power drawing of a normal fold; no gland-like spaces seen.

appears in the lumen of the tube and an inflammatory exudate appears in the markedly swollen folds of the tube (Fig. 42). The epithelium of the folds is bathed in pus; this combined with the marked cellular infiltration in the folds causes the epithelium to become soggy and in certain areas it ultimately disappears; as the connective tissue stroma of some of the folds are no longer covered by epithelium the two folds become confluent. Some men refer to this as an adhesion between the folds.

If the infection is sufficiently severe it may destroy the entire epithelial lining of the tube. If not, the pus and exudate are absorbed and the epithelium which has not been destroyed



A B

FIG. 42. A. Same magnification as normal tube Figure 41. Tube folds are markedly swollen, pus is seen in the lumen of the tube, and areas of lost epithelium are numerous; B. high power of markedly swollen fold to show lost epithelium.

begins to grow and to cover the stroma of the folds. In those areas where the stroma has become confluent, the epithelium, is not able to grow over the surface of the folds and therefore forms gland-like spaces (Fig. 43). In other areas the epithelium grows over the confluent folds restoring the lumen of the tube. With complete healing the lumen of the tube may be entirely restored (Fig. 44). The exudate in the folds and in the lumen having been absorbed, all that is left to indicate the presence of a previous infection are the gland-like spaces.

GROSS PATHOLOGY

Gonorrheal infection of the tube is a true salpingitis, an infection of the lumen of the tube. It is remarkable how quickly the tube assumes a tortuous appearance. Patients operated upon within forty-eight to seventy-two hours of the onset of the acute infection, under the mistaken diagnosis of acute

appendicitis, have shown tortuosity of the tubes. This is probably due to an attempt on the part of the tube to accommodate itself to the marked swelling of the folds. In this

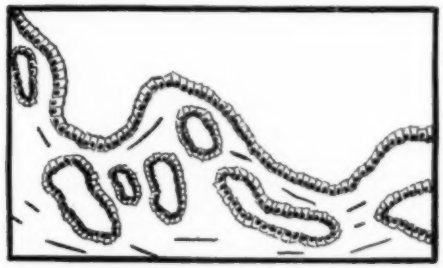


FIG. 43. Healed gonorrheal infection of the tube. The epithelium has grown over the surface of the folds; in those areas where the epithelium could not reach the surface it has formed gland-like spaces.

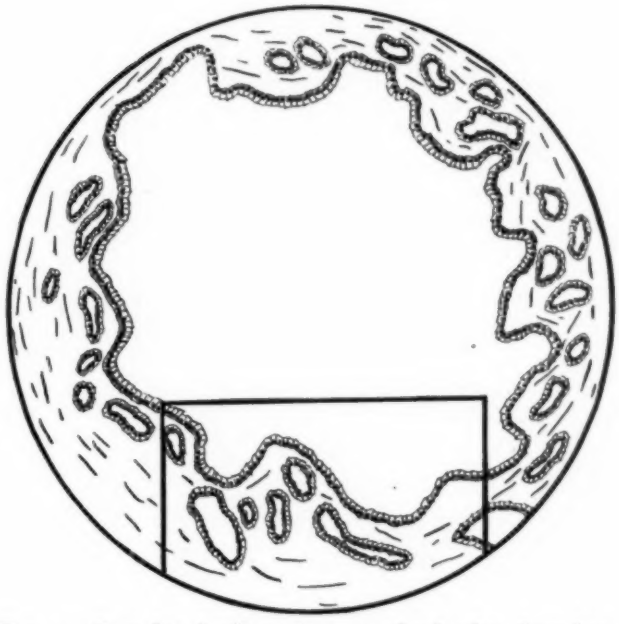


FIG. 44. Complete healing of a gonorrheal tube; there has been no interference with the lumen of the tube. Gland-like spaces in the wall of the tube and the absence of folds are the only indication of a previous infection.

acute stage the tube is bright red; the fimbria project beyond the end of the tube, they are bright red and markedly swollen.

Pus exudes from the fimbriated end of the tube. Owing to its increase in weight the tube promptly falls into the pelvis and lies on the back of the uterus (Fig. 45). The pus pours from the

FIG. 45. Acute gonorrheal salpingitis, first attack, tortuous tubes have fallen behind the uterus; pus seen coming from the fimbriated ends of the tubes.

fimbriated end of the tube into the general peritoneal cavity, causing gonococcal peritonitis. This is a true pelvic peritonitis in contradistinction to the pelvic cellulitis of postabortal

infection (parametritis) which may give a similar clinical picture.

This infection is not always localized to the pelvis; occasionally a general peritonitis follows. The gonococcus causes a self-limited disease with the result that the infection quickly disappears and all that will be found as evidences of a preexisting generalized peritonitis are a few thin, filmy adhesions between the surface of the liver and the anterior abdominal wall (called violin string adhesions by Curtis). It is because of this that one may occasionally find patients with tubal infection presenting right upper quadrant symptoms, or gallbladder symptoms.

With this out-pouring of pus from the fimbriated end of the tube and the development of an acute pelvic peritonitis, adhesions form rapidly. As the gonococcus causes a true salpingitis and as the only place from which pus can exude is the fimbriated end of the tube on the posterior side of the uterus, the adhesions form only around the end of the tube between it and the ovary, broad ligament or uterus. In some cases the infection clears up and the patient makes an uneventful recovery with no further symptoms. Examination of the pelvis of this type of patient will show only a few thin adhesions around the fimbriated end of the tube and no other gross pathology.

What is the future history of these patients? Does every woman who has a gonorrheal salpingitis of necessity develop pus tubes?

No. If this is her only attack she may recover completely and all her symptoms may disappear.

Does every woman who has had a gonorrheal salpingitis become sterile?

No. As a result of a single infection she does not of necessity become sterile. The fimbriated ends of the tubes may be only partially closed and the lumen of the tube only slightly impaired. Histological examination of the tube would show a follicular salpingitis or pseudo-adenoma, and the lumen of the tube would be large enough to allow the passage of an impreg-

nated ovum (Fig. 44). In some cases there is a closure of the tubes by thin, filmy adhesions around the fimbriated ends; these are the patients who are helped by tubal insufflation. After inflating these tubes (200 mm. Hg) for several months in succession, some of these adhesions may be broken through by being blown out and the fimbriated end of the tube may again become patent.

What is the clinical course in those cases who have more than one attack or where the infection does not clear up? As long as the tube is patent at its uterine end, and the uterine cavity is connected with an infected cervix or the cervix is exposed to infection, these patients can reinfect themselves. Whether these are reinfections with different organisms (other consorts) or a relapse of the original infection is very difficult of differentiation. When these reinfections occur, if the fimbriated end of the tube is not closed, pus may again escape into the pelvic peritoneum causing an extension of the pathology. The ovary lying close to the fimbriated end of the tube may become adherent or the tube may curl itself around the ovary thus forming a tuboovarian mass. The fimbriated end of the tube may become adherent to the posterior wall of the uterus or the broad ligament, thus closing the opening and allowing the pus to collect in the tube with the formation of a pus tube. If the fimbriated end of the tube does not become adherent to some other structure, the end of the tube may close in the following way: There is a band of connective tissue which surrounds the fimbriated end of the tube; when the acute inflammation occurs, the fimbria, which have become congested and swollen, close the end of the tube which becomes markedly swollen due to the retained pus. As the tube increases in size it swells beyond the closed fimbriated end. The latter retracts, flattens out and disappears. The only evidence of a preexisting fimbria found at operation is a small scar.

A hydrosalpinx is usually the late result of a previous gonorrheal infection of the tube. Several cases have been followed through the acute stage of gonorrheal salpingitis and later operated upon for hydrosalpinx. The hydrosalpinx is

apparently due to either an absorption of pus, leaving a clear fluid, or an infection of so low a grade as to be unable to produce pus.

Why is a pus tube found on one side and not on the other if both sides are simultaneously infected?

There are two reasons: (1) The virulence of the infection on both sides may vary or (2) the infection when it ascends may cause a destruction of the lumen of the tube on one side with subsequent closure at its uterine end. The inflammation in the outer portion of the tube disappears and as a result of the closure of the uterine cornu, the ascending reinfection from the uterine cavity cannot reach the outer end of the tube and reinfection cannot take place. In the other tube where the connection with the uterine cavity was maintained, either autogenous or exogenous reinfection may occur following a subsidence of the primary infection with the formation of a pus tube. The difference between a salpingitis and a pyosalpinx or pus tube is only one of degree.

Clinically, the differentiation between a postabortal infection with parametric exudate and a salpingitis with early peritonitis may be quite difficult. With each exacerbation the patient with salpingitis may spill or express a small quantity of pus from the fimbriated end of the tube into the peritoneal cavity thus causing a pelvic peritonitis. As a result there is an exudate into the cul-de-sac of Douglas; and on vaginal examination a solid resistance is felt similar to that felt in a parametric exudate. The differentiation between the two conditions even with a very careful history may be very difficult. However, as the peritonitis recedes and some of the exudate is absorbed, one is able to feel the tubes and make an accurate clinicopathological diagnosis.

Certain complications, such as a leaking tube or a ruptured pus tube, are not infrequent.

Leaking Tubes. It is not unusual for a small opening to appear either in the wall of the tube or between the tube and the ovary allowing the pus to leak into the pelvic peritoneum, preesnting the syndrome of a general peritonitis, high tempera-

ture, rigid abdomen, diffuse tenderness, distention, etc. The symptoms of the acute peritonitis usually subside promptly. Occasionally an abscess in the cul-de-sac may develop which can be drained through the vagina. However, unless there are very definite indications, colpotomy is to be avoided as it makes future laparotomy more difficult. This abscess is a true pelvic abscess in contradistinction to the postabortal parametric abscess secondary to cellulitis of the broad ligament; in the latter the abscess is in the pelvis but not in the peritoneal cavity. The parametric abscess is extraperitoneal between the layers of the broad ligament. This abscess can and should be drained by colpotomy (extraperitoneal drainage).

Ruptured Pus Tubes. A ruptured pus tube is not as unusual a complication as one is led to believe from the literature or the textbooks. When a pyosalpinx ruptures, there is a sudden release of a large quantity of pus into the peritoneal cavity with all the symptoms of an acute abdominal catastrophe, very similar to that seen in ruptured ectopic pregnancy. The patient becomes seriously ill, she is in shock, may be pulseless and die within six to eight hours (Fig. 46).

The line of demarcation between a leaking tube and a ruptured pus tube is frequently very narrow depending upon the amount of pus released at any one time. The management of the two conditions are diametrically opposed. Ruptured pus tubes, if seen early, e.g., within eight hours of rupture, should be operated upon immediately if the patient's condition warrents. As a rule these patients are in severe shock, frequently succumbing to the original shock, and are very poor surgical risks. What form of surgery should be done will have to be selected according to the individual case. If the patient is not operated upon immediately, then late operation should not be performed as the patient will probably overcome the infection, as long as she has survived the original shock. In the late cases the chances of overcoming and localizing her infection are better without an operation than with it.

In a majority of cases the patient with a leaking tube will be able to localize her infection in the tube or with the formation

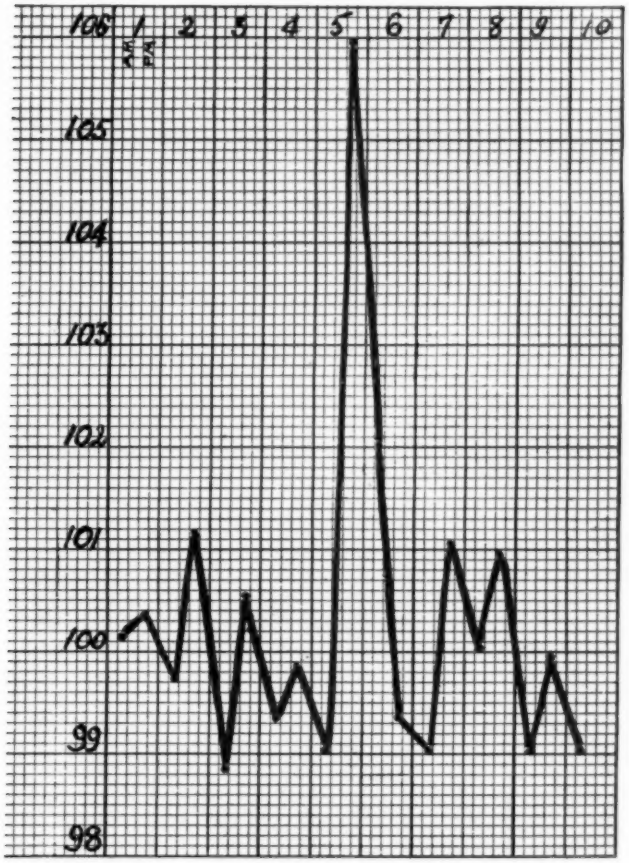


FIG. 46. Mrs. J. K. had bilateral pus tubes and was receiving palliative treatment. On the tenth day in the hospital (marked 5 on chart) at 12:30 p.m. she was seized with a sudden sharp pain in the right lower abdomen. She went into shock; blood pressure dropped to 0/0 then rose to 80/60 in two hours following vigorous treatment. At noon her temperature was 99.4, pulse rate 120; at 8 p.m. her temperature was 100.8, pulse rate 116; at midnight her temperature rose to 106 and the pulse rate to 144. The blood pressure all this time was below 100 mm. Hg. She was operated upon three weeks later and a collapsed tube was found on the right side and a pus tube on the left. She made an uneventful recovery.

of a pelvic abscess. She should not be operated upon but should be treated symptomatically. If the leaking tube is operated upon one of four courses may be followed: (1) the leaking tube may be removed and the abdomen closed without drainage; (2) the tube may be removed and the abdomen drained; (3) the tube is not removed and the abdomen drained; (4) the tube is not removed and the abdomen is closed without drainage. Just which course is the best one to follow is very difficult to state at this time as a sufficient number of operated cases have not been observed. Our opinion at the present time leans towards removing the tube and closing the abdomen with drainage. This, however, is a moot question and requires further study.

Gross Pathology of Gonorrheal Tubes—the Pathology Seen on Opening the Abdomen. If a patient with a *primary acute gonorrheal salpingitis* (less than one week old) is operated upon both tubes are usually found to be about the thickness of a lead pencil, bright red, wavy in appearance and hanging down into the pelvis. Pus will exude from the fimbriated end of the tubes. The fimbriae are markedly congested, bright red and there are no adhesions present.

Pathology Seen in Patients with Repeated Infections of the Tubes. Tubes which have been the seat of repeated infections are swollen and sausage-shaped. The fimbriated end is closed and is adherent to the posterior wall of the uterus, the ovary, or the broad ligament, etc. There are, as a rule, no adhesions between the surface of the tube and the adjacent structures except at its fimbriated end, due to the fact that the gonococcus causes a true infection of the lumen of the tube. Adhesions occur only at the fimbriated end of the tube from the leakage of pus at this point.

How far down behind the uterus do the tubes fall? There is no single condition in the pelvis where the young gynecologist makes more mistakes than he does in attempting to find the fimbriated end of a pus tube. As a rule (not absolute) the fimbriated end of the tube rarely drops below the level of the internal os. All too frequently the young operator goes too low

to look for the fimbriated end of the tube and thereby injures the sigmoid.

In the primary gonorrheal infected tube the mesosalpinx is not thickened, as the infection extended through the uterus to the tubes, for the gonococcus does not ascend along the lymphatics. In patients who have repeated tubal infections, particularly where other organisms enter the picture, a thickening of the mesosalpinx may be observed.

Routine Medical Treatment of Gonorrheal Salpingitis

A woman who is financially able to take care of herself and who is willing to follow instructions carefully can be promised an almost complete recovery from her gonorrheal infection by proper medical treatment. If reinfection can be prevented practically every primary gonorrheal infection of the tube can be cured without operation. The difficulty in a large city hospital is that the patient will not follow the instructions given to her. She may want to but frequently cannot follow them out. Since, she is economically unable to take care of herself when sick, she must return to work too soon; besides, she cannot afford to interrupt her work too frequently, as she will lose her job. Therefore a great many of these patients must be operated upon, not because of the pathology or symptomatology they have, but because they must be returned to economic independence as soon as possible.

What Is the Medical Routine?

1. The patient must have absolute rest in bed, being denied even bathroom privileges. The tubes, being markedly congested and inflamed, will cause pain on the slightest motion with an increased absorption of toxins and a rise in temperature.

2. The patient is placed in low Fowler's position. The head of the bed is not to be raised more than 12 inches. This will allow the exudate to gravitate to the pelvis.

3. She is made to drink water, orange juice, lemon juice, vichy, etc. as much as she can absorb, with a minimum of 3000 c.c. of fluid a day.

4. She is given a plentiful diet with a very low residue.

5. She must have a daily bowel evacuation. This is very important. If a patient's bowels are not moved regularly every day, the rectum becomes full. The inflamed tubes and exudate are close to the rectum. A brisk cathartic such as a dose of castor oil sets up marked peristalsis, with irritation of the tubes and a rise in temperature. This exacerbation may produce a much sicker patient than was occasioned by the primary infection. *Patients with acute pelvic disease must not be allowed to become constipated.*

Mineral oil, one tablespoonful every morning, and milk of magnesia, one tablespoonful at night may be given. If this causes the bowels to be too loose, one is discontinued. If these patients develop a diarrhea, they should be given a boiled milk and barley-water diet. If this does not control the diarrhea, deodorized tincture of opium should be given.

If the patient does not have a bowel movement with milk of magnesia and mineral oil, an enema should be given. *Never give a more drastic cathartic.*

6. An ice bag to the abdomen, on one hour and off one hour, is very comforting to the patient.

7. In some cases morphine or codeine may have to be given for severe pain. They should however, be avoided, as they tend to constipate the patient. If morphine is necessary for severe pain, it is best given at night so that the patient has a good night's rest. Avoid the use of antipyretics (coal tar products) as they tend to lower the temperature. The fever in gonorrheal salpingitis has a very deliterious effect on the organisms and is the attempt on the part of the body to rid itself of the invading host.

8. Foreign proteins, such as boiled skimmed milk, is of great value where the patient has been in the hospital for three or four days and her temperature has not subsided. She may be given 10 c.c. of boiled, skimmed milk every other day intramuscularly or subcutaneously for six doses. Before giving the first dose the patient should always be tested as to her sensitivity to milk by giving her a small intradermal wheal. If there is no reaction, she may receive her intramuscular injection.

The use of a commercially prepared foreign protein, although more expensive, has a definite advantage in that one is using the same amount of foreign protein with each injection. In using boiled skimmed milk the quantity of foreign protein varies from day to day.

9. The Priessnitz application can be very comforting to the patient. This consists in taking a sheet, ringing it out in cold water and wrapping it around the patient's abdomen. Over this is placed a large piece of flannel or a large bath towel. This may give the patient considerable relief from pain.

10. Elliott's treatment* is not to be used during the very acute stages or when the patient has a very high temperature. In the subacute and chronic stages it is very efficacious.

11. Diathermy may also be used after the acute symptoms have subsided.

Elliott's treatment and diathermy can be used with high temperatures if there is a cul-de-sac opening and the patient can drain her exudate through this opening. If she cannot drain, do not use Elliott's treatment or diathermy unless the pathology is subacute.

12. All forms of sex trauma, excitement or intercourse, should be avoided. Sex trauma in a subacute or subsiding salpingitis may precipitate an acute attack. These patients reinfect themselves, not only from their own gonococci but from the gonococci of their consorts. There is great difficulty in these patients in distinguishing between reinfection and relapse.

13. Polak felt that menstruation, "causing periodic physiological storms," was a factor in prolonging the attack of salpingitis and advocated the production of a temporary amenorrhea by *x*-ray irradiation. This has not been generally accepted.

14. The use of hot vaginal douches, for their cleansing and heat effect is frequently advocated.

15. The use of the "Hot Box" hyperpyrexia in combination with diathermy or Elliott's treatment is still in the experimental stage but promises to be the best means of attacking the primary gonorrheal infection in the female.

*See chapter on Office Gynecology.

The Surgical Management of the Gonorrheal Infected Tube

Before discussing the surgical management of gonorrheal infection a resumé of some accepted facts would not be amiss.

1. Gonorrhea of the tubes is a self-limited disease.
2. The gonococci require oxygen to live.
3. Gonococcal pus in a closed cavity sterilizes itself.
4. Complete drainage of a gonorrheally infected area produces a cure.
5. Incomplete drainage with low oxygen tension allows for the best growth of the gonococci.

These 5 postulates must constantly be borne in mind when considering the surgical management of any case.

Not many years ago it was the general rule that every patient with an acute pelvic infection was to be operated upon as soon as the diagnosis was made. The acute tube was treated in exactly the same manner as acute appendicitis.

In 1910 Simpson presented a paper, "Delayed operation in gonorrheal salpingitis and pelvic infection," claiming that by the delayed operation he was able to reduce the postoperative morbidity and mortality. The mortality in the immediate operation was 6 per cent to 7 per cent whereas his mortality with the delayed operation was less than 1 per cent. In spite of this fact, it was years before the delayed operation was generally accepted. Even today one will not infrequently find an article on the immediate operation of pelvic infection.

An analysis will clearly show that an immediate operation is neither indicated nor necessary. When a patient presents herself with an acute pelvic infection the possibilities of a postabortal or gonorrheal infection frequently cannot be differentiated at that particular time. If it is postabortal, the patient certainly should not be operated upon because an extraperitoneal infection will be transformed into an intraperitoneal one. If it is gonorrheal, the infection is self-limited (Postulate 1). Curtis has shown that by waiting until the

temperature is normal for two weeks, the pus in the tube becomes sterile, hence, operation in the acute stage is disadvantageous. Early operation is sometimes advocated as a means of diminishing the amount of destruction which may occur as a result of the gonorrheal infection. This is only a half truth. It is true that this will limit the extension of the disease but an operation performed at this time will sacrifice valuable organs associated with the tube and involved in the acute pathology.

An operation performed after the acute process has completely subsided will show that these organs are free from infection and therefore do not require removal. Delaying the operation does not mean further extension of the disease nor the formation of denser adhesions—streptococcal adhesions become dense, gonorrheal as a rule, do not. Operations performed during the acute stage of the infection—particularly in the second or later attacks—are fraught with technical difficulties that may be insurmountable. The broad ligament is usually markedly thickened and friable making the control of hemorrhage by clamp or ligature a difficult procedure. Every organ in the pelvis seems to bleed when touched and the control of this bleeding is not easy.

If on opening an abdomen, a markedly thickened broad ligament with a tube riding on top is found, it is most probable that one is dealing with a parametric exudate of postabortal origin and not a gonorrheal salpingitis. Do not remove this broad ligament mass as it will probably have live streptococci in its lymphatics. Streptococci can live in the broad ligament many (19) years after the original infection.

If on taking a history one finds the patient's symptoms are directly referable to an old abortion, do not operate on that patient. If a patient is operated upon with a mistaken diagnosis of an acute appendicitis and an acute salpingitis is found, do not remove the normal appendix. Do not touch the pelvic organs; simply close the abdomen. Those patients whose abdomen is opened through such an error in diagnosis and who have nothing removed will have a smoother convalescence. Even the

removal of a normal appendix may cause a protracted temperature and a lingering convalescence.

Simpson's requirements for operation, which are much more stringent than the ones followed at Harlem Hospital; were:

1. Normal temperature for three weeks;
2. Normal blood count;
3. No reaction either in blood count or temperature after repeated vaginal examinations.

Today the sedimentation rate of the red blood cells has been added to Simpson's laws. On many gynecological services no operation is performed on any patient whose sedimentation rate is less than one hour. This seems to place too much emphasis upon one laboratory test. The sedimentation test should be used as added laboratory data in the same light as the blood count or temperature. The sedimentation time alone should not be regarded as of sufficient importance to contraindicate an operation. When a patient's sedimentation rate is less than 18 mm. in thirty minutes, some other clinical or laboratory data will strengthen the case against surgery. However, it has been found that patients fulfilling all of Simpson's laws but whose sedimentation time was less than one hour and more than thirty minutes could be operated upon safely.

When should the patient with a gonorrheal salpingitis be operated upon?

Rule 1. Never operate upon a patient following her first attack of salpingitis.

Patients may present themselves in their first attack with pus tubes—this does not indicate the necessity of an operation. The amount of recession of pelvic pathology under proper medical care is remarkable. The number of patients with healed gonorrheal salpingitis who have had children and never had a second attack is legion.

Rule 2. Do not operate for pathology, operate to prevent and cure incapacitating symptomatology.

Little, of Montreal, has shown that one can drain the pus from a large pus tube, inject 10 per cent turpentine in oil and

cure the patient of her symptoms; yet the pathology still remains in the pelvis.

The majority of patients treated in our municipal institutions must earn their livelihood. They present themselves following repeated attacks of salpingitis due to reinfection and continued sex trauma. Owing to these attacks they are physically incapacitated and cannot support themselves. These patients are operated upon not to remove the pathology present so much as to prevent a recurrence of the incapacitating symptoms, which prevent them from working and subject them to loss of employment.

Rule 3. If the temperature of a patient with pelvic inflammatory disease does not subside in three weeks under good medical care, that patient probably has ovarian involvement (ovarian abscess or tuboovarian abscess).

When a patient is put to bed and given good medical therapy, her temperature should subside within two to three weeks, if her infection is limited to the tube. If the infection has involved the ovary or formed a tuboovarian abscess, the temperature may be sustained a much longer time. Gonoccocal pus in the lumen of the tube (in a closed cavity, Postulate 3) sterilizes itself. Spreads made from the pus obtained by puncture of ovarian abscesses have never shown gonococci. Smears and cultures have shown either no organisms, short chain streptococci or colon bacilli. This has led to the belief that the gonococcus is not the etiological factor of ovarian abscesses. If this premise be true then one may readily understand the maintainance of the infection in the ovary with its associated temperature long after the infection in the tube has sterilized itself.

Rule 4. Operate: WHEN—

A. The temperature has been normal for two weeks.

B. The blood count is normal.

C. There is no temperature or blood count reaction following a vaginal examination.

D. The sedimentation time is 18 mm. in thirty minutes or longer.

Operative Technique

The abdomen is opened by a left paramedian vertical incision one finger's breadth to the left of the midline from the symphysis to the umbilicus, down to and exposing the fascia of the external sheath of the rectus muscle. All bleeding points are clamped and ligated. A small incision is made in the fascia with a knife, scissors are then introduced under the fascia downward as far as the symphysis, the scissors are opened and withdrawn open. The fascia is cut down to the symphysis. The assistant carries out the same procedure upward for the full extent of the wound. This use of the scissors allows a free edge of fascia for closure.

The medial leaf of the fascia is grasped by three Allis clamps, lifted and by sharp dissection the fascia is separated from the underlying muscle medially until the properitoneal fat is exposed, the two index fingers are introduced and the muscle separated for the full extent of the wound. The lower insertion of the rectus muscle at the midline frequently has to be cut with scissors down to the symphysis (*one inch below is worth two above*). The muscle is retracted to the left—while the fascia is drawn to the right by the middle Allis clamp, the upper and lower Allis clamp being removed. The peritoneum is grasped with two smooth forceps and incised with a knife or scissors, care being taken to avoid injury to the underlying intestines. The edges of the opening are grasped with two clamps and the incision extended for the full extent of the wound—*watch for the bladder in the lower angle of the wound.* The self-retaining retractor is inserted and before any investigation of the pelvis is made, the pelvis is walled off completely from the rest of the abdomen by three large laparotomy pads. The first laparotomy pad is placed in the left fossa of the abdomen, lifting the sigmoid and intestines over to the patient's left, placing this pad as far to the left as possible. The second pad is placed in the patient's right fossa, pushing the cecum, appendix and some of the small intestines upward and to the right. The third pad is placed in the middle, this lifts

the rest of the small intestines out of the pelvis. A large Deaver retractor is placed over the pads to hold them in place (Fig. 47).

The uterus and pus tubes are thus visualized. The next step

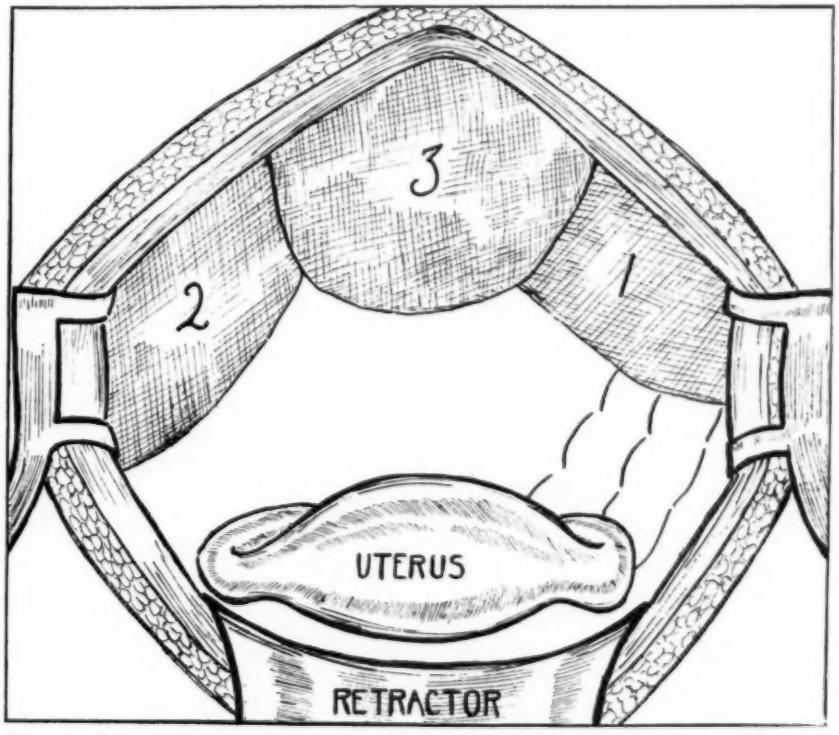


FIG. 47. Laparotomy pads, 1, 2 and 3 are inserted, in order, thus walling off the pelvis from the rest of the abdomen.

is to mobilize both tubes and ovaries. To do this it is essential to remember the pathology. In its early stages the gonorrheal tube drops into the pelvis and adhesions form around its fimbriated end. This becomes fixed and the pus tube grows towards the midline on the posterior surface of the uterus. This brings two serous surfaces in contact, the posterior wall of the uterus and the tube, these adhesions are readily separated.

To deliver the tubes a line of cleavage must be found. The best line of cleavage is from the midline outward on the posterior wall of the uterus. The hand is introduced down the midline separating the tube from the posterior wall of the uterus until the adherent fimbriated end of the tube is reached.

There, owing to the irritation of the pus dense adhesions may be found.

In trying to deliver the fimbriated end of the tube one must

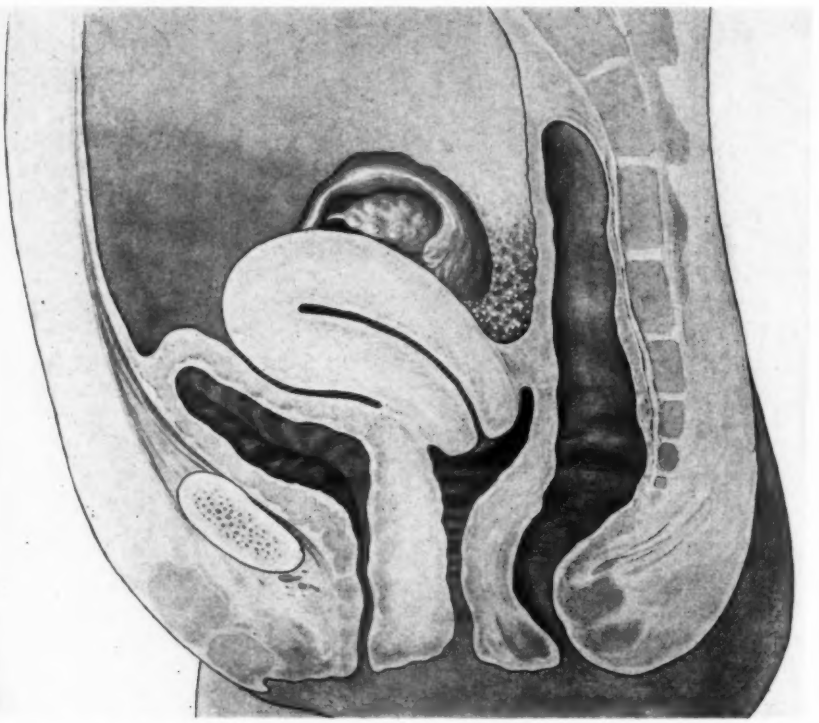


FIG. 48. Pus tube showing fimbriated end buried in exudate and adherent to the posterior wall of the uterus at about the level of the internal os of the cervix.

not forget that the tube as a rule does not go deeply into the cul-de-sac. The fimbriated end of the tube usually becomes adherent to the vault of the vagina and sigmoid at about the level of the internal os (Fig. 48). This lapse of surgical judgment is one of the most frequent causes of injury to the sigmoid.

Axiom: *In separating the tube from the bowel it is better to leave a piece of tube on the bowel than a piece of bowel on the tube.*

If the tube is not adherent to the bowel but to the posterior surface of the broad ligament or uterus it can be delivered with its accompanying ovary by a scratching motion on the posterior wall of the broad ligament.

The tube and ovary are delivered into the wound. As a rule these organs can be separated from each other without difficulty by using the index finger and thumb in a pinching motion.

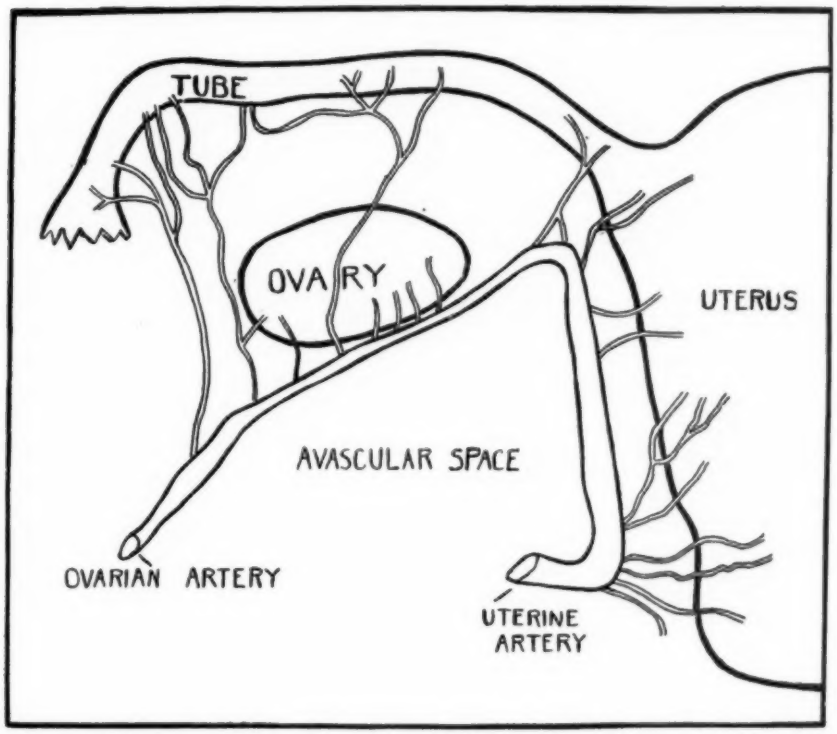


FIG. 49. Diagrammatic representation of the blood supply of the tube and ovary.

If not, a clamp can be applied close to the tube, mechanically separating the tube from the ovary. The tube must be removed with as little damage to the blood supply of the ovary as possible and no ovarian tissue should be sacrificed unless absolutely necessary.

An examination of the blood supply of the ovary (Fig. 49) shows one vessel arising from the uterine artery, going outward toward the ovary and a second coming from without in through the infundibulopelvic ligament. Interference with the blood supply to the ovary, in some way modifies the regressive changes in the primoidal follicles with the formation of multiple small ovarian cysts.

The ovary and the tube having been separated the next step is the removal of the tube itself. In doing this, place the clamps as close to the tube as possible cutting the mesosalpinx

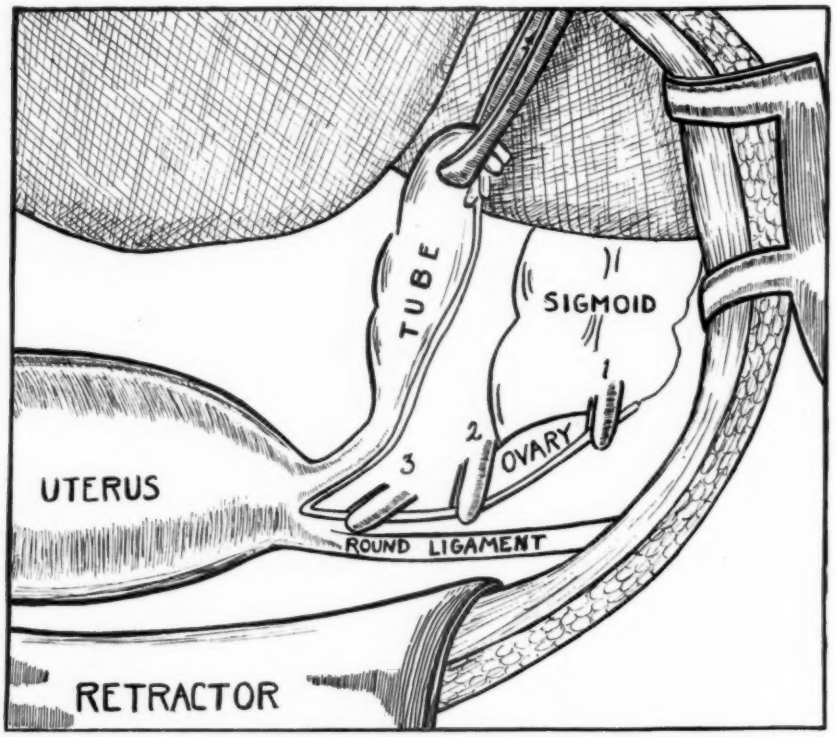


FIG. 50. The tube separated from its mesosalpinx, three clamps, 1, 2, 3, control the bleeding points.

between the clamp and the tube. The tube is supplied by three groups of small vessels, one arising close to the uterus, the second at about the middle and the third near the outer end of the mesosalpinx. Three artery clamps should control all of the arterial bleeding (Fig. 50, 1-2-3). Occasionally some dilated veins are found which cause some hemorrhage; these should be clamped and tied. The tube is thus freed down to the uterine end.

Before excising the uterine end of the tube a figure of "8" stitch of No. 2 plain catgut cut in three on a Mayo needle is introduced at the cornu, the first bite (Fig. 51, A to B) being a light one and the second (Fig. 51, C to D) going fairly deeply. The ends of the suture are held by the little or ring

fingers. The two index fingers are placed in the middle part of the "8" making a large loop (Fig. 51E-E). The operator then makes a V-shaped incision into the cornu of the uterus excising

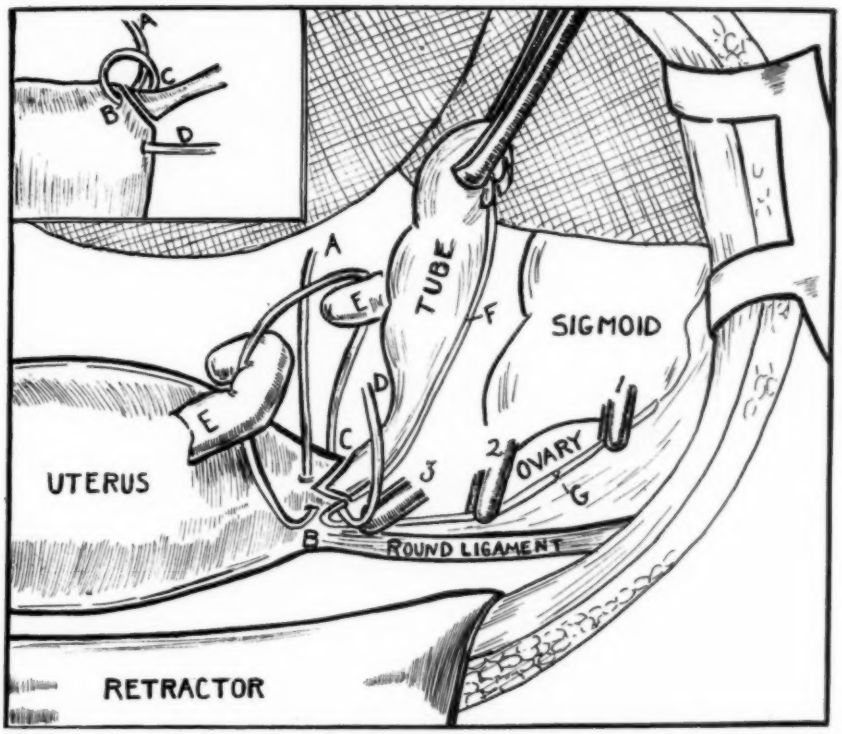


FIG. 51. Excision of the cornu of the uterus with the tube. Insertion of figure of "8" stitch, A to B, taking a small bite in the fundus; C to D, taking a deeper bite. Insert shows anterior view of this suture, 1, 2, 3, clamps on the bleeding points in the cut edge of the mesosalpinx. The excision of the tube at the cornu is wedge-shaped.

the uterine end of the tube. The two ends of the suture, A and D, are drawn taut and tied thus closing the opening. This suture is left long, a clamp applied and used as a traction stitch (Fig. 52T).

Why is the uterine end of the tube excised in this manner?

Because (1) it gives good peritonealization, leaving no raw surfaces; (2) it removes the infected cornu of the uterus; (3) if the cornu is left in, there is a tendency to the formation of adenomyosis or endometriosis.

If a patient, in whom the cornu of the uterus has not been excised is reoperated, it is not infrequent to find a protuberance

as large as the end of the finger at the cornu of the uterus. If this is examined microscopically it shows a chronic salpingitis, adenoma, endometriosis or a small abscess.

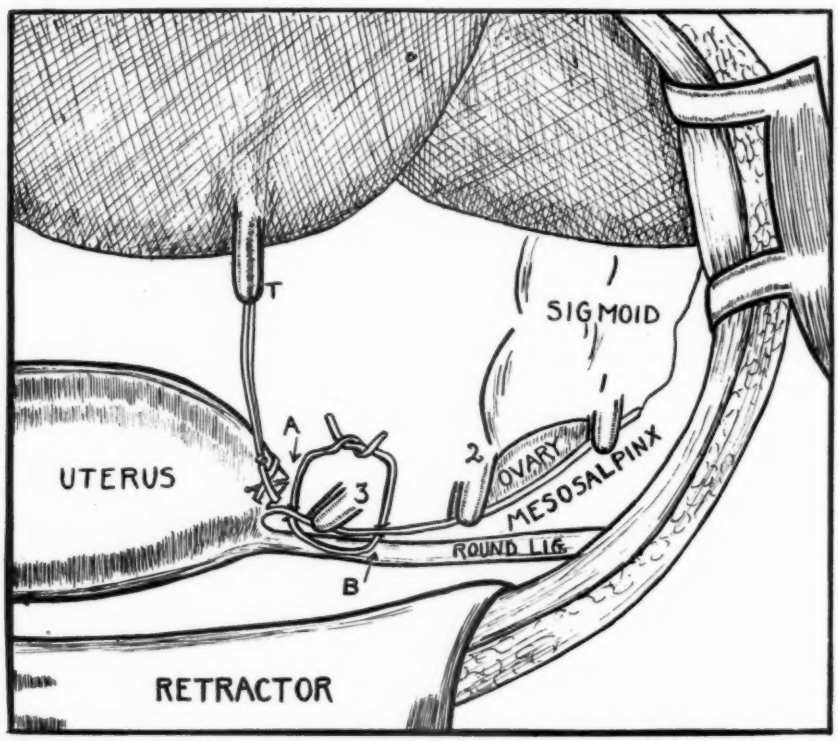


FIG. 52. The tube has been removed and the figure of "8" stitch in the cornu has been tied and is held with a clamp, T. The first suture ligature is applied from behind forward entering the mesosalpinx at A and reentering the mesosalpinx from before backward at B. It is then tied on the posterior surface of the mesosalpinx.

Following the removal of the tube, the cut edge of the mesosalpinx with its three clamps and the ovary are in the wound. To remove the clamps and control the hemorrhage, suture ligatures are applied. A suture ligature consists of a piece of No. 2 plain catgut cut in three, on a medium sized Mayo needle. If the operator is standing on the patient's left and is removing the left tube the needle is passed from behind forward (Fig. 52A) from the posterior layer of the mesosalpinx to the anterior, starting the suture just proximal to the clamp. The needle is then passed from before backward (Fig. 52B)

just below the outer edge of the clamp and tied. Insert and tie the rest of the suture ligatures on the patient's right mesosalpinx in the same way placing all sutures from behind for-

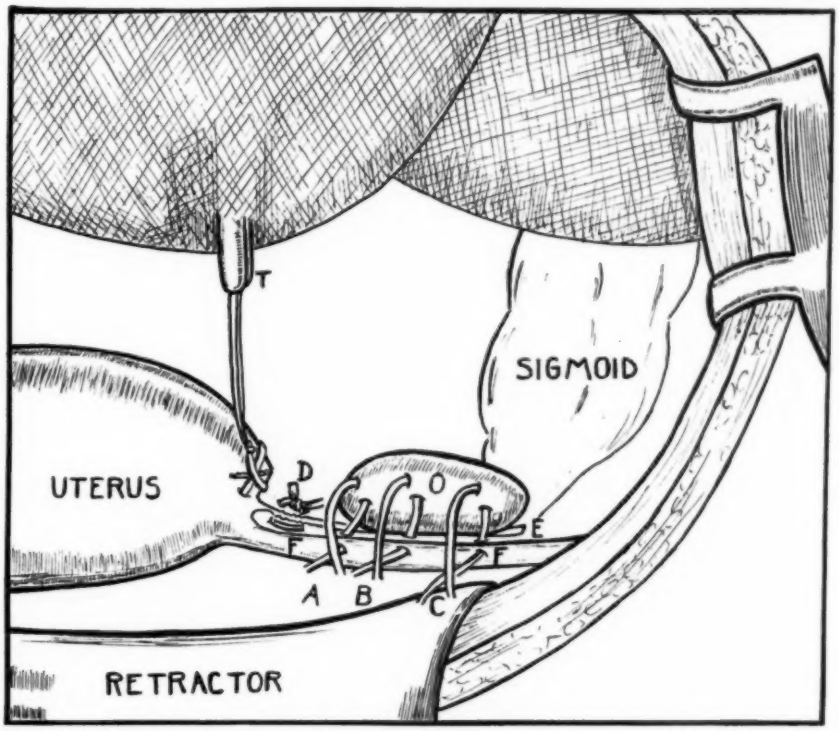


FIG. 53. Following removal of the tube the ovary, O, is suspended to the round ligament using three sutures, A, B, C. This also helps cover the raw edge of the mesosalpinx.

ward. It requires three or four suture ligatures to control the bleeding of the mesosalpinx.

There is now left the cut edge of the broad ligament and the ovary on the posterior surface of the broad ligament and the round ligament on the anterior surface of the broad ligament. Holden frequently states that "The ovary gives no symptoms unless it is in bad company." If the ovary is left alone it will drop into the pelvis and become adherent to the raw surface from which the pus tube was removed. These adhesions become fixed and the patient may complain of pain and dyspareunia. To prevent this, the ovary is suspended by suturing it to the round ligament by a suture ligature. The outer end of the ovary is sutured to the outer end of the round

ligament (Fig. 53). Another suture is taken at the middle and one at the internal pole of the ovary. These sutures when tied help to peritonealize the cut edge of the broad ligament and also lift the ovary out of the pelvis.

The same procedure is followed in removing the left tube.

Occasionally in the delivery of the tube the line of cleavage may be difficult to find, probably due to operating too soon. The temperature, etc., may be normal but there has not been a sufficient recession of the pathology. In such a case, the tube may be removed backwards. The figure of "8" suture at the cornu of the uterus is inserted first and the uterine end of the tube excised. This allows the placing of the clamps on the broad ligament close to the tube from uterine end outward. The line of cleavage can usually be found near the midline extending outward just under the tube between it and the mesosalpinx. The ligament is cut distal to the clamp and close to the tube. By repeating this process one can gradually deliver the tube up to its adherent fimbriated end, which thus becomes more accessible and its separation from the sigmoid or the posterior wall of the uterus can be made under vision. All clamped tissue is suture ligated and the clamps are removed. The ovary is then treated in the manner already described.

Following the removal of the tubes the uterus should be suspended. Whether a one point fixation, an Olshausen suspension or a Gilliam is used is immaterial; but some form of suspension must be performed or the fundus of the uterus will fall into the cul-de-sac and become fixed.

In a study of 100 consecutive cases of pus tubes operated upon at Harlem Hospital it was found that in those patients where no suspension was performed 27 per cent had fixed retroflexions on follow-up. In those where a suspension had been done, only one fixed retroflexion was found. It made no difference what form of suspension was used; even the simple one point suspension seemed to prevent the development of a fixed retroflexion.

Another procedure occasionally followed where bilateral pus tubes are present is the Bell-Beuttner operation. In this

operation after separating the tubes from the mesosalpinx to the uterine horn, instead of doing a simple V-shaped excision of the cornu a wedge-shaped piece of the fundus of the uterus

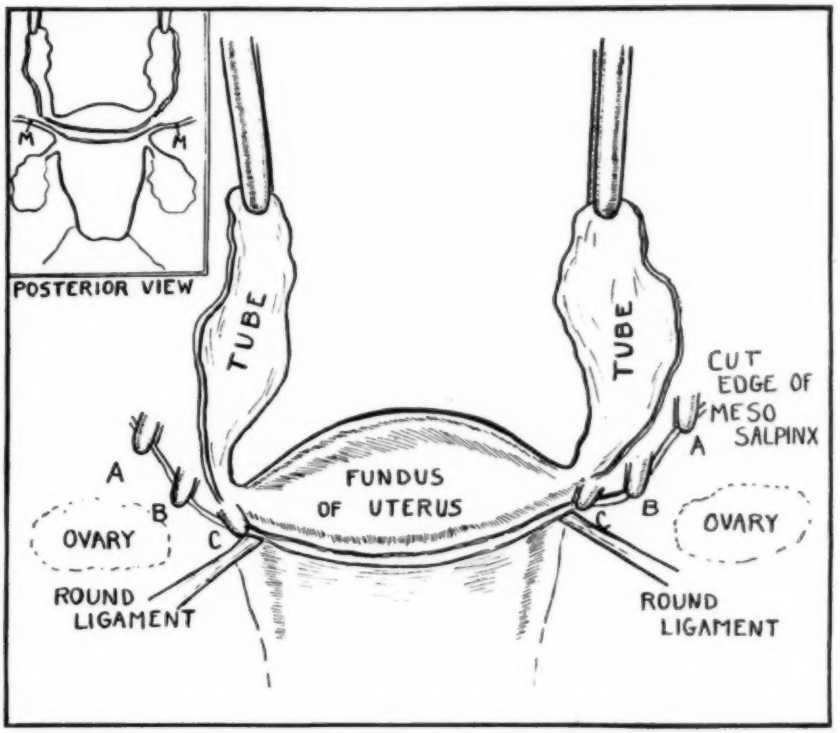


FIG. 54. Bell-Beuttner operation. Elliptical incision around the fundus of the uterus removing tubes and fundus in one mass. Insert shows posterior view of incision; M, cut mesosalpinx.

is removed. This procedure is particularly valuable where fibroids are found in the fundus and it is desirable to retain the menstrual function.

Step 1. The first step is the same—the *factors* must be separated and identified, e.g., both tubes must be freed from all adhesions and delivered into the wound.

Axiom: *Never do any pelvic surgery until all the factors have been identified and isolated, both tubes, both ovaries and both round ligaments, uterus, sigmoid and bladder. Once these are isolated and identified, pelvic surgery becomes comparatively simple.*

Step 2. The mesosalpinx is clamped and cut close to the tube so as not to disturb the blood supply of the ovary. If

the ovary is to be removed the clamp is placed on the infundibulopelvic ligament.

Step 3. An elliptical incision is made around the fundus

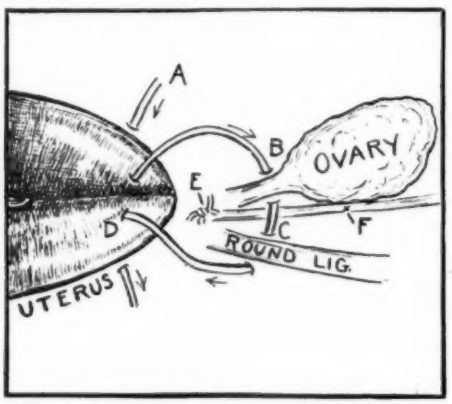


FIG. 55. Fixation of the ovary and round ligament into the newly formed cornu of the uterus. The suture enters from behind forward at A and a good bite of the posterior wall of the uterus is taken. The suture is then passed through the round ligament of the ovary at B, the round ligament of the uterus at C, and finally enters the anterior wall of the uterus from within out at D. E, suture ligature on the cornual branch of the uterine artery. F, cut edge of mesosalpinx.

and a V-shaped excision is performed so that a wedge-shaped piece of the fundus is removed (Figs. 54, 56). A sufficient amount of the fundus is excised so as to remove all the pathological tissue, yet enough of the uterus is left to maintain menstruation. The cavity of the uterus is swabbed with iodine on an applicator. There are usually two large bleeders at each cornua (cornual branch of uterine, see ovarian blood supply, Fig. 49), these should be clamped before the excision is begun. The other bleeding is controlled as it occurs. A figure of "8" suture is placed around the tip of the clamp, controlling the cornual branch of the uterine (Fig. 55-E). This is tied and the clamp removed. The same procedure is carried out on the other side.

The round ligament of the ovary and round ligament of the uterus are fixed into the new formed cornua of the uterus with a suture ligature (Fig. 55). This suture is introduced into the

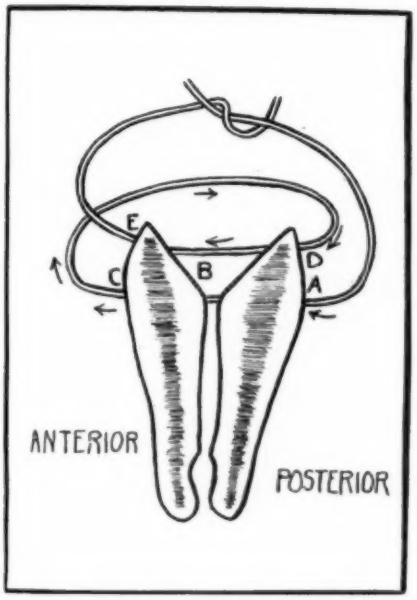


FIG. 56. Modified Stewart stitch closing the excised portion of the fundus of the uterus. The suture is inserted from behind forward at the lower edge of the wedge, A; it then passes through the lower edge of the anterior lip, B to C; it then enters the upper edge of the posterior lip at D, and catches the upper edge of the anterior lip at E. These sutures are not tied until they are all inserted.

posterior wall of the uterus from behind forward, A. It catches the edge of the round ligament of the ovary, B, goes forward and catches the round ligament of the uterus, C, and then catches the anterior lip of the uterus from within outward, D. When this suture is tied it helps suspend the ovary as well as peritonealize the cornu of the uterus.

The cut surface of the uterine wall is closed with a modified Stewart stitch (Fig. 56). A deep bite is taken from behind forward at the lower level of the posterior lip of the wedge, A. It is passed through the lower level of the anterior lip of the

wedge, B, reappearing on the anterior wall of the uterus, C. The suture then enters the top of the posterior lip of the wedge on the posterior surface, D, from behind forward, and is brought through the top of the wedge of the anterior lip from behind forward, E.

Don't tie these sutures until they are all placed. Otherwise difficulty will be encountered in placing the last few stitches deeply enough. When these sutures are tied, there is good coaptation of the edges with practically complete hemostasis. Suture ligatures are then placed on the mesosalpinx in the regular manner and the clamps removed. The uterus is fixed to the anterior abdominal wall with a double No. 2 chromic stitch cut in two, on a Mayo needle. This is passed through the posterior wall of the uterus, from below upward (one point fixation). The needle is then passed through the anterior abdominal wall near the midline, catching the peritoneum and some of the posterior rectus sheath; this suture goes from below upward, is tied and cut short. Another method of holding the uterus forward is to open the anterior vesicouterine fold of peritoneum, separate it for a sufficient distance and suture it to the posterior wall of the uterus.

When many adhesions are separated with the formation of a large number of new raw areas—in the absence of an acute purulent infection—500 c.c. of sterile bovine amniotic fluid may be introduced into the peritoneal cavity just before closing. This seems to produce a smoother convalescence.

Surgical Treatment of Recurrent Gonorrheal Tubal Infection in Young Patients

In studying a large series of cases of tubal infection, certain facts were discovered.

1. That in spite of the known fact that a gonorrheal infection of the tubes was always bilateral, patients were repeatedly seen who had a pus tube on one side and a fairly normal tube on the other.

As a result of this observation several of these apparently normal tubes were removed and examined. It was found that

in the apparently fairly normal tube there always was an obstruction at the uterine cornu, whereas in the pus tube on the other side, the connection with the uterine cavity seemed to be maintained.

2. That when a hysterectomy was performed on a patient who had a chronic bilateral tubal infection she did not develop any later attacks of salpingitis. In looking over the literature, hysterectomy was found to be described as a treatment for pus tubes (Robinson).

3. That when a patient with quiescant pus tubes was adequately treated so as to remove all gonorrheal infection from her genitalia (cervix, urethra, etc.) and she was separated from her consort to prevent reinfection, her tubal infection cleared up and did not recur.

4. Simpson and Curtis have shown that gonorrhea of the tube is a self-limited disease and the organisms in the tube die within two weeks, so that the tube cannot reinfect itself. *The infection must come from without the tube.*

5. That those patients, whose tube had been resected close to the uterus for sterilization purposes never developed salpingitis, showing that gonorrheal infection does not go by way of the blood stream or lymphatics but travels along the uterus to the tubes.

As a result of this study, five conclusions were reached:

1. When a patient had a complete occlusion at the uterine end of the tube, tubal infection did not recur and pus tubes did not develop;

2. That the uterus was the necessary avenue by which the infection reached the tubes from the cervix and the external genitalia;

3. That even in the presence of the uterus with a total absence of infection from the internal os downward, reinfection did not occur;

4. The tube did not spontaneously reinfect itself;

5. In those cases where the connection between the uterine cavity and the tubes had been broken, no cases of pus tubes developed.

It was then argued that if these conclusions were correct, in order to prevent reinfection of the tubes, one of four procedures could be followed:

1. Clear up all infection and do not allow sex trauma.
2. Do a hysterectomy.
3. Remove the infected tubes with or without fundectomy, and
4. Resect the tubes at the cornu of the uterus.

Which Procedure Should Be Followed?

Procedure 1 could be followed if the patients would cooperate, but it is practically impossible to prevent sex trauma. Reinfections have occurred in some cases following sex trauma where one could absolutely exclude reinfection from the consort. As a result of the impossibility of control, the first procedure although it can be carried out, is usually doomed to failure.

Procedure 2—Hysterectomy. This is rather radical surgery for infected tubes; patients will not submit to it, the mortality and morbidity is too high and it breaks every principle of preserving as much of the pelvic organs as possible.

Procedure 3—Removal of the tubes with or without resection of the fundus. This is an excellent procedure but still somewhat radical. In removing the tubes with or without a piece of the fundus, frequently there was interference with the blood supply of the ovaries and on the follow-up of these patients, ovarian cysts were often found.

Procedure 4—Resection of the tubes. In this procedure a minimum of surgery is performed and if this procedure would clear up the condition and prevent reinfection, it should be the method of choice.

Little, of Montreal, showed that it was not necessary to remove the pus tube to cure the patient's symptoms, nor was it necessary to remove the mass. He punctured the pus tubes, drew off the fluid and injected 10 per cent turpentine in oil. The symptoms cleared up but the masses still remained.

Holden did salpingostomies on 12 patients. He simply incised the pus tube along its anterior surface from the clubbed end to the uterine cornu, removed the pus and then suspended the incised tubes to the round ligament by three or four sutures turning the raw surface of the incised tubes downward.

All of this pointed toward the fact that pus tubes could be left in, if reinfection could be prevented.

Technique of Tubal Resection for Treatment of Pus Tubes

The abdomen is opened with the usual left paramedian incision. The pelvis is walled off with the three abdominal pads.

Step 1. The pelvic pathology is thoroughly examined. This is absolutely essential because the operation of *tubal resection should not be done on cases with infected ovaries.* To examine the pelvic pathology thoroughly it may be necessary to separate the tubes and ovaries from their adhesions.

In gonorrheal tubes (pure) the adhesions will be at the fimbriated end only. In the first series of patients in whom this procedure was carried out nothing was done to the tubes and ovaries except to resect the cornu. The question was then raised as to the possibility of a low tube and ovary causing late pain. It was, therefore, decided to deliver these tubes and ovaries out of their adhesions and suspend them to prevent late postoperative pain.

Step 2. The right tube and ovary are delivered into wound. A hot laparotomy pad is placed in the bed of the tube and ovary to control the oozing. The tube is grasped close to its origin at the uterine end with a small artery clamp and a figure of "8" stitch is inserted in the cornu of the uterus. Care should be observed that this suture does not injure the ovarian branch of the uterine artery (see Fig. 49). The suture is held open by the index fingers (see Fig. 51).

Step 3. A V-shaped excision of the uterine end of the tube is made being careful not to injure the ovarian branch of the uterine artery. The operator draws the figure of "8" stitch taut and ties it. This is left long and a clamp applied.

Step 4. No. 2 plain catgut, cut in two, on a Mayo needle is taken and passed through the mesosalpinx on the distal side (toward the fimbriated end of the tube) of the clamp, but

FIG. 57, A. Figure of "8" stitch tied and clamp applied to ligature. B. Suture through mesosalpinx tied around proximal end of tube and left long. Needle with suture passed through posterior wall of uterus below suspensory ligament of ovary. (Falk. *Am. Jour. Surg.*, 33: 509–512 [Sept.] 1936.)

fairly close to it. This is tied by the assistant. The operator then grasps the round ligament of the ovary with an Allis clamp and lifts it. The assistant allows the clamp on the proximal end of the tube to fall to the outer side of the Allis clamp.

The operator sews the long end of this suture to the posterior wall of the uterus below this point (Fig. 57). The Allis clamp is removed and the clamp which is left on the end of the tube is

FIG. 58. All sutures tied and cut short. Proximal end of tube is thus buried. (Falk. *Am. Jour. Surg.*, 33: 509–512 [Sept.] 1936.)

allowed to drop in the pelvis. The operator ties the long end of the suture to the short end on the tube; this causes the end of the tube to be inverted under the tube. The clamp is removed. The suture is cut fairly short (Fig. 58).

Step 5. The same procedure, Step 1 to 4, is carried out on the left side.

Step 6. The appendix is removed and some form of uterine suspension, preferably a one point fixation, is carried out.

With this procedure a minimum amount of surgery is performed and reinfection (gonorrheal) is prevented. It reduces the incidence of injury to the ovarian blood supply and causes less morbidity and mortality than any other surgical procedure on the tubes.

[*To be continued in subsequent issues.*]

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